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Technical Service Manual

Part Number: 4110966
Rev: N
Date: 26 May 2004

Vitalert 2000 Series
Vital Signs Monitoring System

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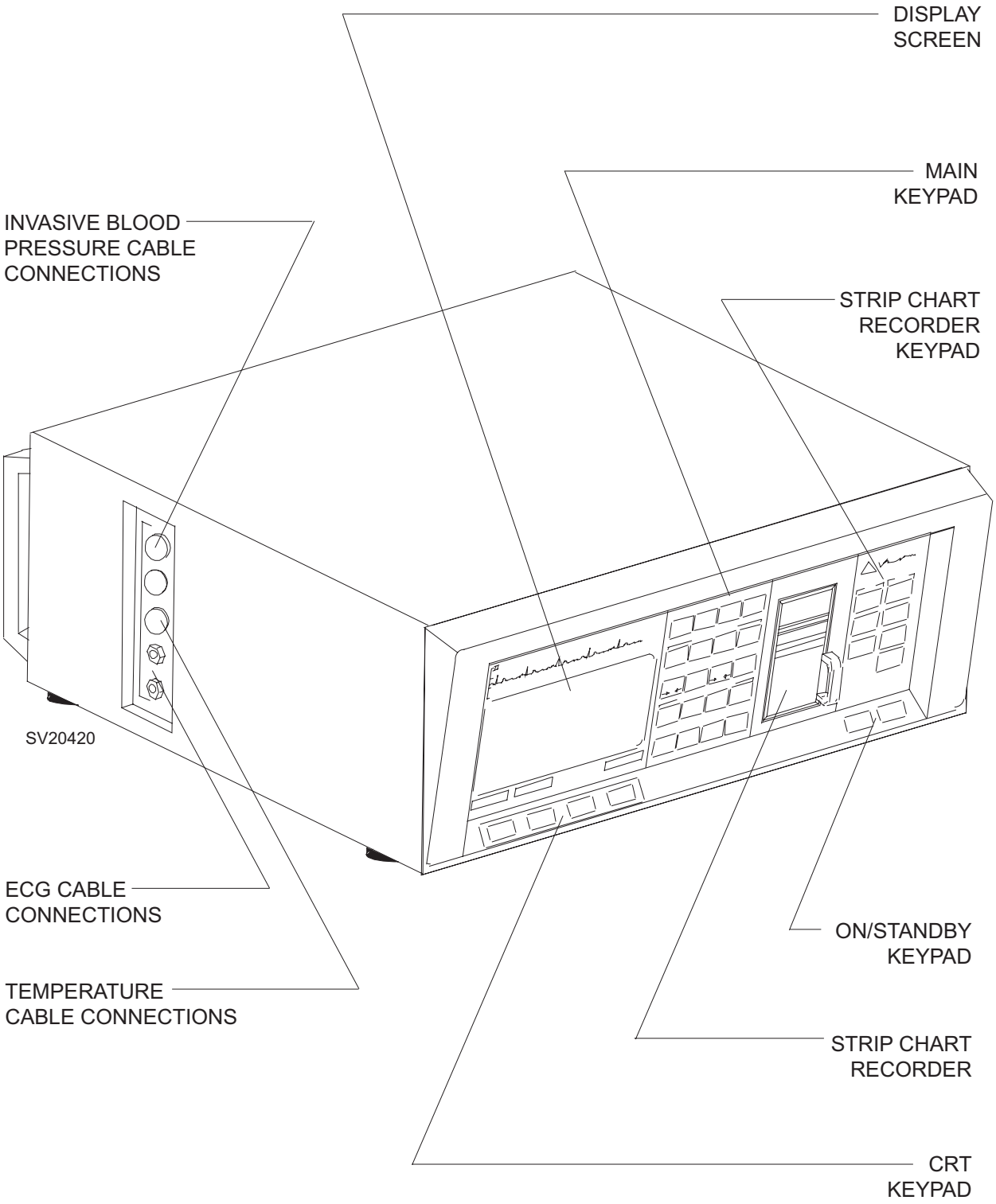
DISPLAY SCREEN
MAIN KEYPAD
INVASIVE BLOOD PRESSURE CABLE CONNECTIONS
STRIP CHART RECORDER KEYPAD
SV20420
ECG CABLE CONNECTIONS
ON/STANDBY KEYPAD
TEMPERATURE CABLE CONNECTIONS
STRIP CHART RECORDER
CRT KEYPAD

1.0 RECOMMENDATIONS

Because of the sophisticated nature of Draeger Medical, Inc. medical equipment and its critical importance in the operating room setting, it is highly recommended that only appropriately trained and experienced professionals be permitted to service and maintain this equipment. Please contact DrägerService® at (800) 543-5047 for service of this equipment.

Draeger Medical, Inc. also recommends that its monitoring equipment be serviced at three-month intervals. Periodic Manufacturer's Service Agreements are available for equipment manufactured by Draeger Medical, Inc. For further information concerning these agreements, please contact us at Draeger Medical, Inc. (800) 543-5047.

Draeger Medical, Inc. products/material in need of factory repair shall be sent to:

DrägerService
3124 Commerce Drive
Telford, PA 18969
(Include RMA Number)

HOW TO USE THIS MANUAL

The manual is divided into several sections. The DIAGNOSTICS section describes self-test and service diagnostics for checking the system functions. An understanding of the on-board service capabilities is necessary before any attempt is made to troubleshoot the unit. The TROUBLESHOOTING section provides troubleshooting guides to assist the TSR in locating the source of a problem. The REPLACEMENT PROCEDURES section contains instructions for removal and replacement of the assemblies that are considered field-replaceable. The ADJUSTMENT AND CALIBRATION PROCEDURES section contains the field procedures needed to restore original system specifications. The Periodic Manufacturer's Service (PMS) PROCEDURE section outlines the steps required to verify the electrical, mechanical and pneumatic safety of the unit and also identifies components requiring periodic replacement.

GENERAL TROUBLESHOOTING GUIDELINES

Troubleshooting the VITALERT 2000 should always begin by communicating with those who observed or experienced a problem with the unit. This may eliminate unnecessary troubleshooting steps. Once a general problem is identified, refer to the troubleshooting flow charts in Section 3 to determine the proper corrective action to be taken.

After a component has been replaced, verify that the unit is operating properly by running the appropriate diagnostic procedure. The PMS PROCEDURE in Section 6 must also be performed after any component has been replaced.

The general arrangement of the VITALERT 2000 Monitor is shown on the opposite page.

A **WARNING** statement gives important information that, if ignored, could lead directly to personal injury.

A **CAUTION** statement gives important information that, if ignored, could lead directly to equipment damage and indirectly to personal injury.

Equipment Class: IEC 601 Class 1, Type BF, continuous

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Disclaimer

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2.0 DIAGNOSTICS

The VITALERT 2000 contains a diagnostic system that monitors certain system functions and records their operational status. A series of tests is performed when the instrument is powered up and the results are displayed on the diagnostics screen shown in Figure 2-1. If any of these tests fail, consult Section 3 for proper corrective action.

The operational status of the VITALERT 2000 is shown at the end of the power-up self-diagnostics and will be one of the following:

FUNCTIONAL: The VITALERT 2000 begins normal monitoring operation.

CONDITIONALLY FUNCTIONAL: Any minor deficiencies are posted, and the operator must press the CONTINUE key. The instrument may continue to be used in this situation, but steps shall be taken to eliminate the problem.

NON-FUNCTIONAL: The self-diagnostic tests reveal a problem in the VITALERT 2000. A summary of the diagnostic results is posted and normal operation is inhibited. The instrument cannot be operated until this condition is corrected.

Further diagnostic functions are available through service screens that can be called up by a Technical Service Representative at the display panel. The following paragraphs provide a description of each service screen that can be accessed through the CRT keys on the display panel. If no display is present upon system power-up, refer to Section 3 of this manual for troubleshooting assistance.

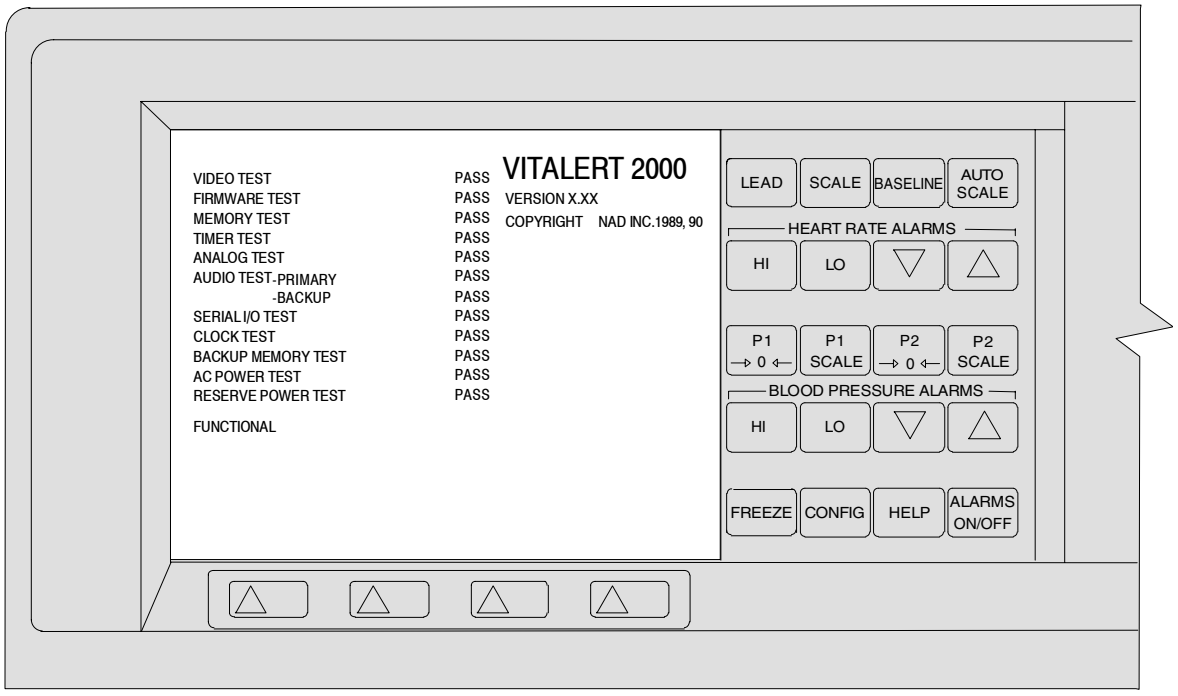

Figure 2-1: POWER-UP DIAGNOSTICS SCREEN

2.1 Service Menu Screen

To access the Service Menu Screen, press and hold the Heart Rate Alarms HI and CONFIG keys, and then press the upper right key on the main keyboard. The Service Menu appears as shown in Figure 2-2.

The Service Menu displays the available service functions. Access to these service functions is gained through the CRT keys below the service screen which temporarily function according to their corresponding on-screen labels. The SELECT key advances the cursor through each service screen option on the menu, and the ENTER key opens the selected service screen. Pressing the MONITOR key at any time induces a hardware reset and returns the user to the Power-up Diagnostics Screen.

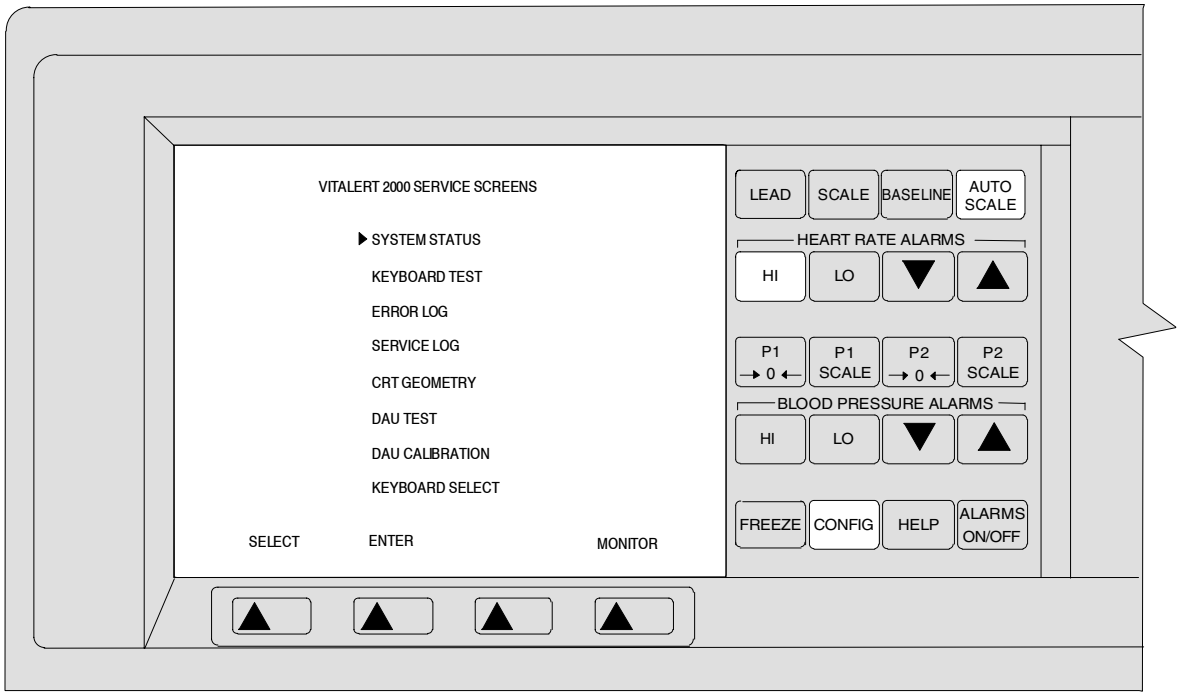

Figure 2-2: SERVICE MENU SCREEN

2.1.1 System Status Screen

To access the System Status Screen, press the SELECT key to advance the cursor to the SYSTEM STATUS option, and then press the ENTER key. The System Status Screen, shown in Figure 2-3, is divided into four parts: Power Supply Status, Internal Cable Status, DAU Status and External Cable Status. To leave this screen, press the EXIT key.

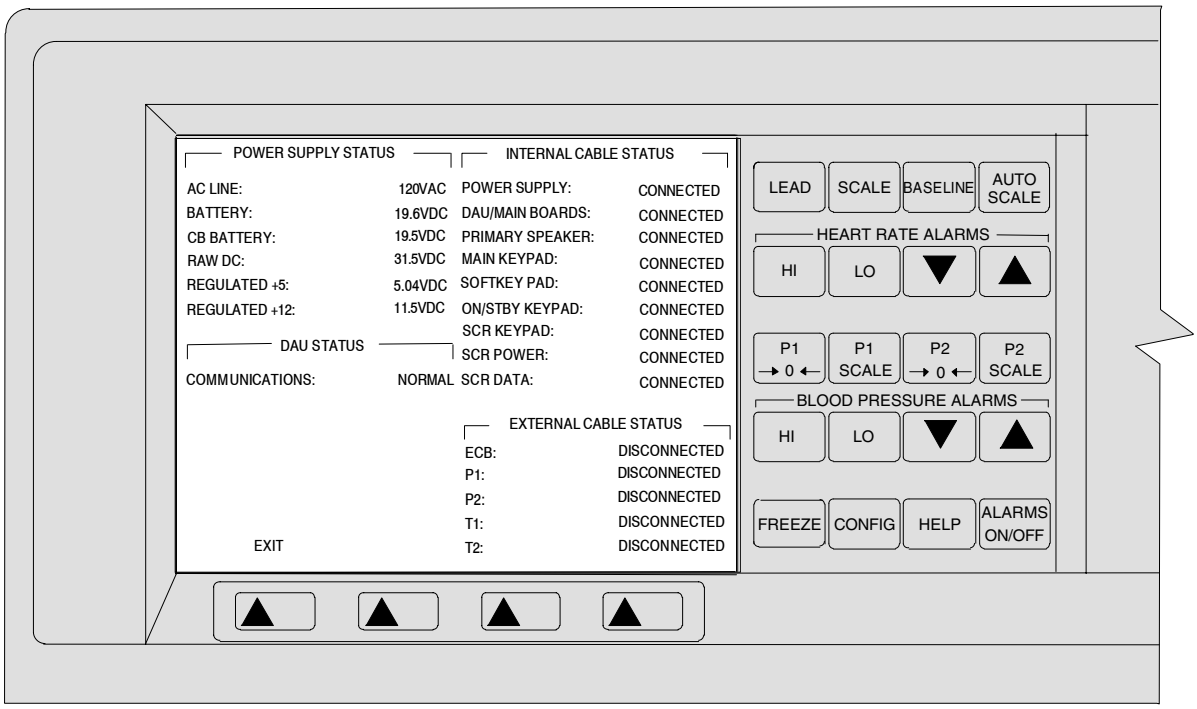

Figure 2-3: SYSTEM STATUS SCREEN

2.1.1.1 Power Supply Status

The Power Supply Status portion of the System Status Screen provides information on the main input voltage and the internal voltages used by the VITALERT 2000 power supply. The six voltages measured and their acceptable ranges are provided in the table below. If these values are not within acceptable ranges, consult the troubleshooting guides in Section 3 for assistance.

VOLTAGE	RANGE
AC LINE	90-130 VAC (On 220 volt units this value is half the actual line voltage.)
BATTERY	18.5 - 22 VDC
CB BATTERY	18.5 - 22 VDC
RAW DC	18 - 35 VDC
REGULATED +5	4.8 - 5.2
REGULATED +12	11.0 - 12.4

2.1.1.2 Internal Cable Status

The Internal Cable Status portion of the System Status Screen shows the status of cable connections on the processor board assembly and the specified system module. The cable connections are listed in the table below.

CABLES	MAIN PROCESSOR BOARD POSITION	MODULE POSITION
POWER SUPPLY	J2	J5
DAU/MAIN BOARDS	J1	J1
PRIMARY SPEAKER	J15	N/A
MAIN KEYPAD	J7	N/A
SOFT KEYPAD	J8	N/A
ON/STBY KEYPAD	J10	N/A
SCR KEYPAD	J9	N/A
SCR POWER	J4	N/A
SCR DATA	J6	N/A

2.1.1.3 DAU Status

The DAU Status portion of the System Status Screen shows the state of communications between the Data Acquisition Unit (DAU) and the main processor board. The status will be either NORMAL or FAULTED. If the status is FAULTED, there is a problem with the DAU/Main Board ribbon cable, the DAU, or the processor board assembly. The Error Log Screen and the DAU Test Screen shall be consulted to determine which module is faulty. If these fail to identify the problem, refer to Section 3 for troubleshooting assistance.

2.1.1.4 External Cable Status

The External Cable Status portion of the System Status Screen shows the status of the patient interface cables connected to the DAU when connected to a patient simulator. The display will show the status of cables ECG, P1, P2, T1, and T2 as either CONNECTED or DISCONNECTED.

If the display shows DISCONNECTED when the cable is firmly connected, there may a be problem with the DAU or with the cable. Check the Error Log Screen and the DAU Test Screen for information to isolate the problem. If these fail to identify the problem, refer to Section 3 for troubleshooting assistance.

2.1.2 Keyboard Test Screen

To access the Keyboard Test Screen, press the SELECT key to advance the cursor to the KEYBOARD TEST option, and then press the ENTER key. The Keyboard Test Screen allows the TSR to check each key on the main keyboard and the SCR keyboard. As each key on the keyboard is pressed, a corresponding key is illuminated on the Keyboard Test Screen, as shown in Figure 2-4. If a diagrammed key on the CRT does not illuminate, there is a problem with the specific keypad, the keyboard setup, or with the processor board. Press the EXIT key last to return to the service menu screen.

Both Type 1 and Type 2 keyboards can be tested via the Keyboard Test Screen. Figure 2-5 shows the configurations for both keyboard types.

NOTE: The Type 2 SCR keyboard can only be used on instruments with Version 2.0 firmware or higher.

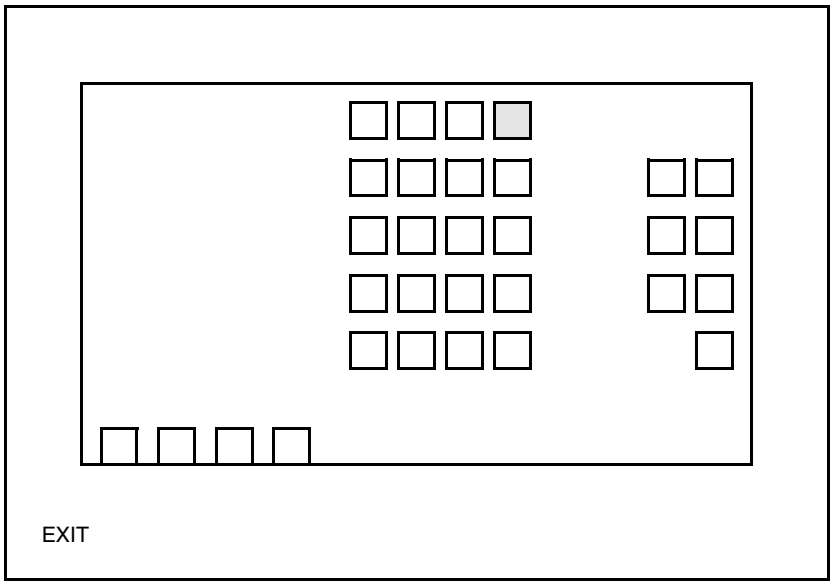

Figure 2-4: KEYBOARD TEST SCREEN

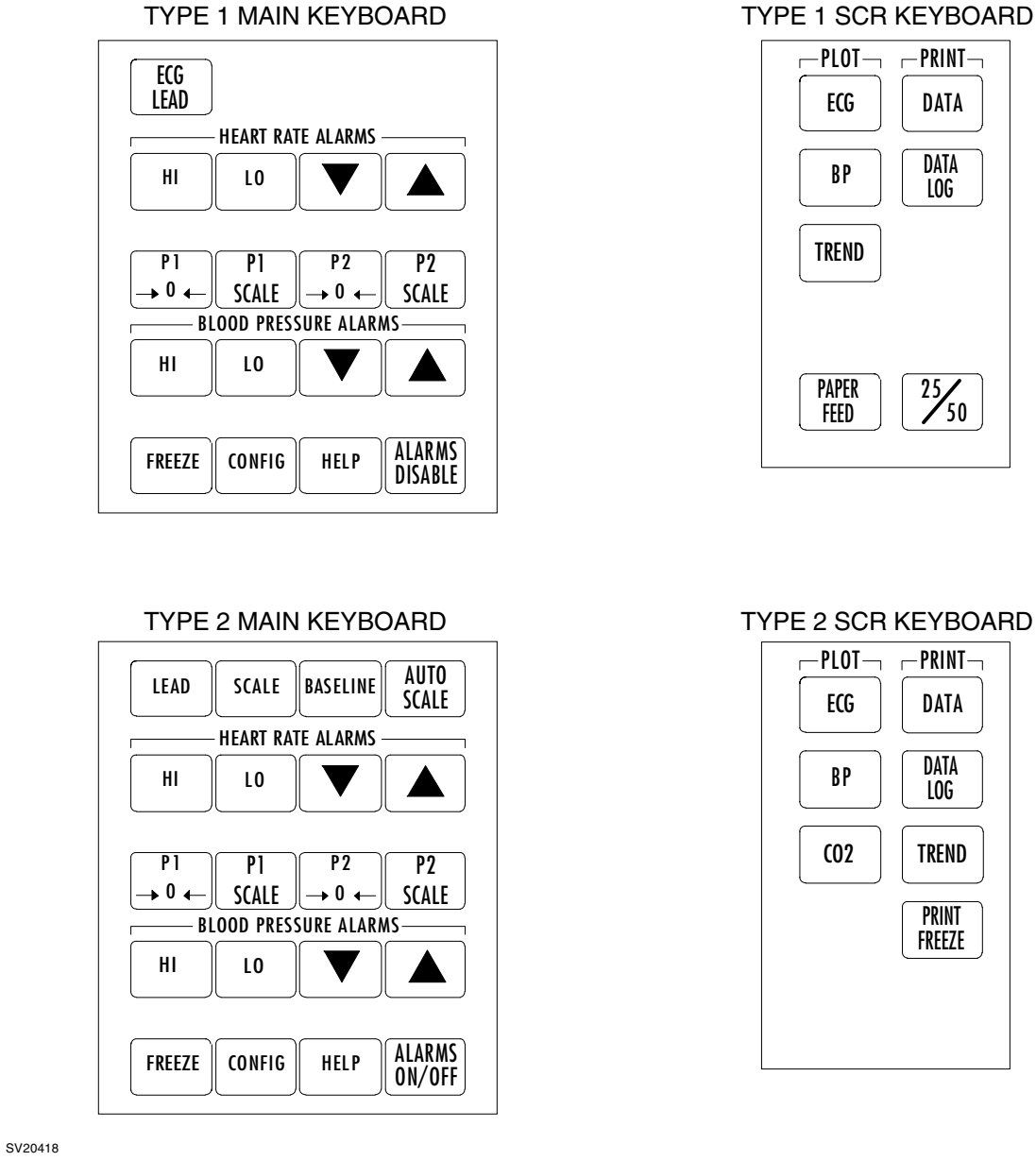

Figure 2-5: TYPE 1 & TYPE 2 KEYBOARD CONFIGURATIONS

2.1.3 Error Log Screen

To access the Error Log Screen, press the SELECT key to advance the cursor to the ERROR LOG option, and then press the ENTER key. The error log is an up-to-date list of errors which have occurred in the VITALERT 2000. The information is stored and will not be lost during an AC power failure or when the instrument is in STANDBY mode.

A typical Error Log Screen is shown in Figure 2-6. A total of 200 entries can be stored in memory, with up to 14 entries on the screen at a time. Each entry consists of a time, date, and message. Off-screen entries can be viewed by pressing the SCROLL UP or SCROLL DOWN keys.

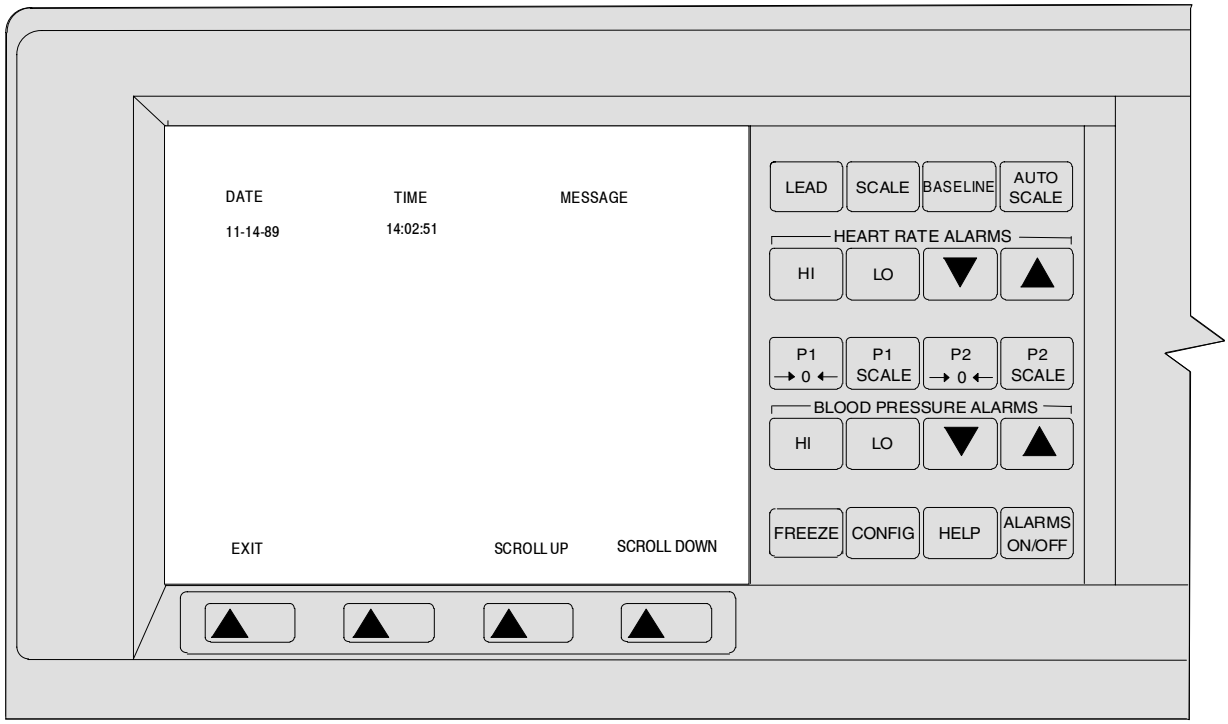

Figure 2-6: ERROR LOG SCREEN

2.1.4 Service Log Screen

To access the Service Log Screen, press the SELECT key to advance the cursor to the SERVICE LOG option, and then press the ENTER key. This screen allows the TSR to view and reset the last service date. It also displays the total number of hours of instrument usage (up to 19999). A typical Service Log Screen is shown in Figure 2-7.

The service date is reset to the current date by pressing the RESET SERVICE DATE key. The CLEAR ERROR LOG key option is for NAD Technical Service use only and shall not be used in the field.

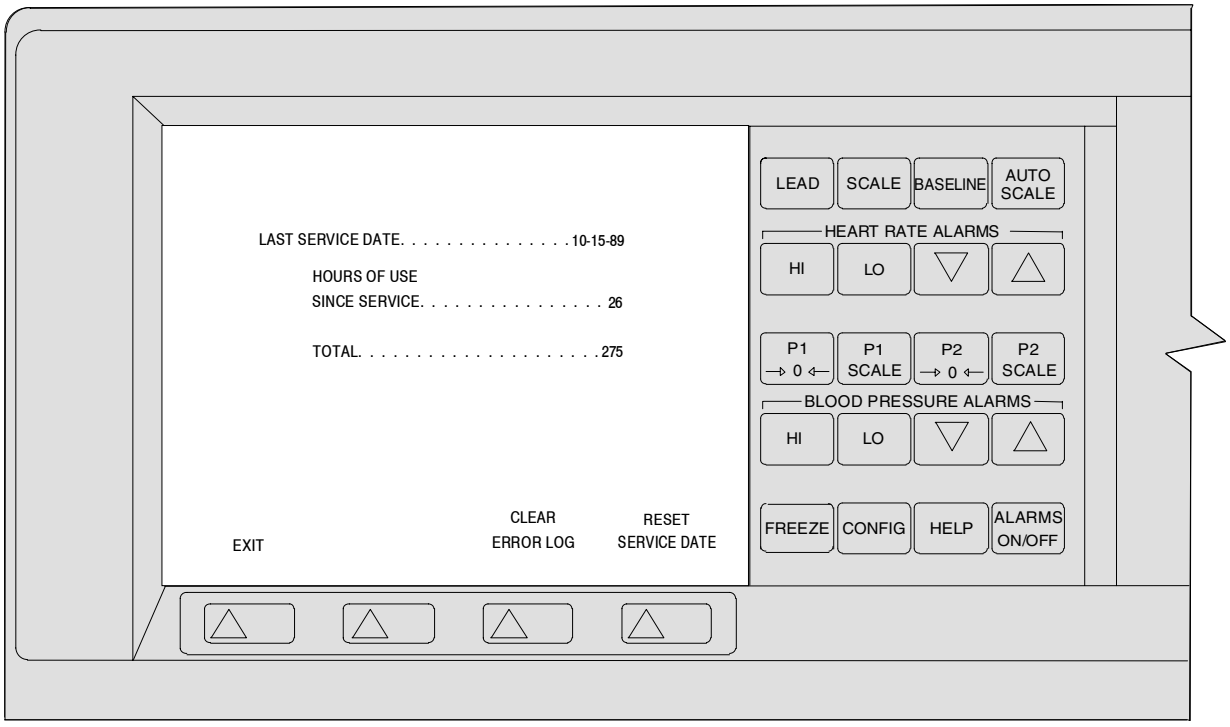

Figure 2-7: SERVICE LOG SCREEN

2.1.5 CRT Geometry

To access the CRT GEOMETRY screen, press the SELECT key to advance the cursor to the CRT GEOMETRY option, and then press the ENTER key. This screen displays a pattern for aligning the CRT as shown in Figure 2-8. The geometrical pattern displayed on the screen moves in relation to the adjustments being performed by the TSR. For more information, see Section 5.1, CRT Adjustment Procedure.

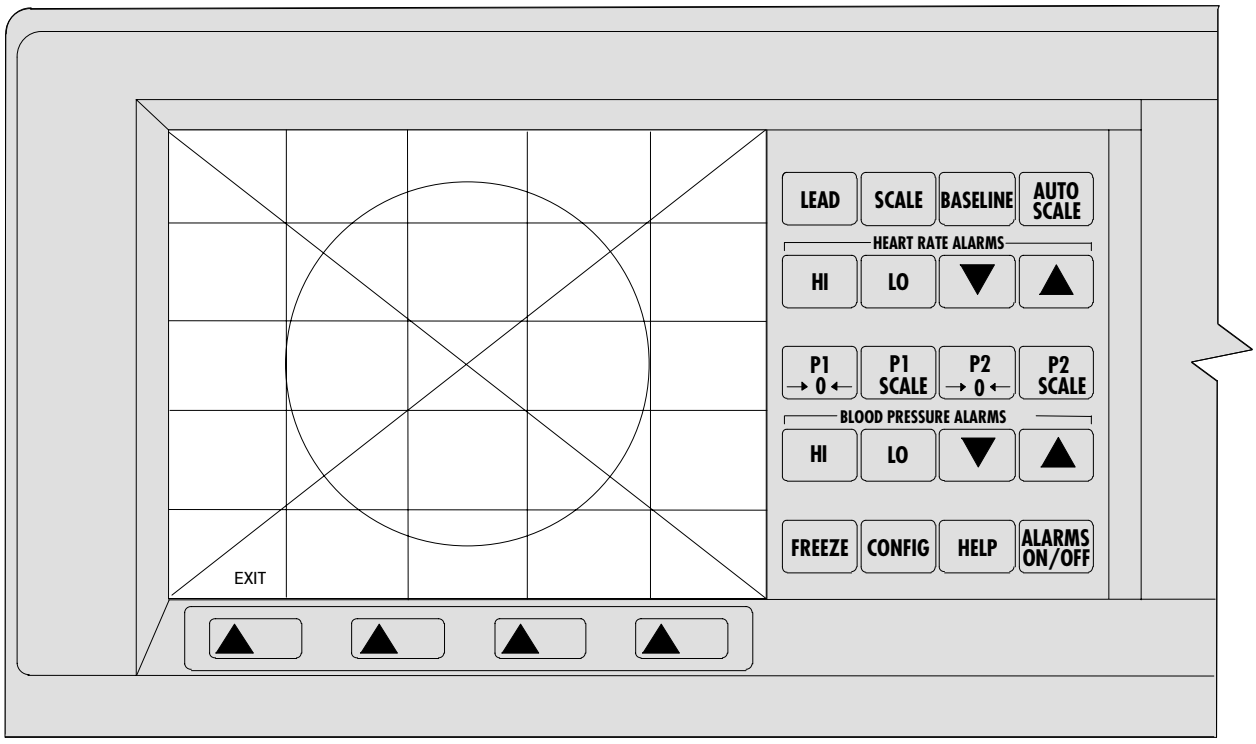

Figure 2-8: CRT GEOMETRY SCREEN

2.1.6 DAU Test Screen

To access the DAU Test screen, press the SELECT key to advance the cursor to the DAU TEST option, and then press the ENTER key. This screen allows the TSR to verify system performance and to identify system problems. It displays status, waveform, and command information and serves as a troubleshooting tool for the VITALERT 2000, since many calibration errors, IBP errors, ECG errors, or temperature errors can be identified by comparing the data on this screen to the correct specifications (see Section 5).

The screen is divided into two parts (see Figure 2-9). The upper half of the screen shows one of seven selectable displays: DAU measurement and status, ECG waveform, P1 waveform, P2 waveform, a communications display, T1 waveform and T2 waveform (T1 and T2 waveforms only on instruments with firmware prior to Version 2.0). The bottom half of the screen contains a list of display and command options which are selected by pressing the SELECT PREVIOUS or SELECT NEXT key (to advance the cursor up or down the option list), followed by the ENTER key.

Table 2-1 at the end of this section lists definitions for the VITALERT 2000 service screen commands.

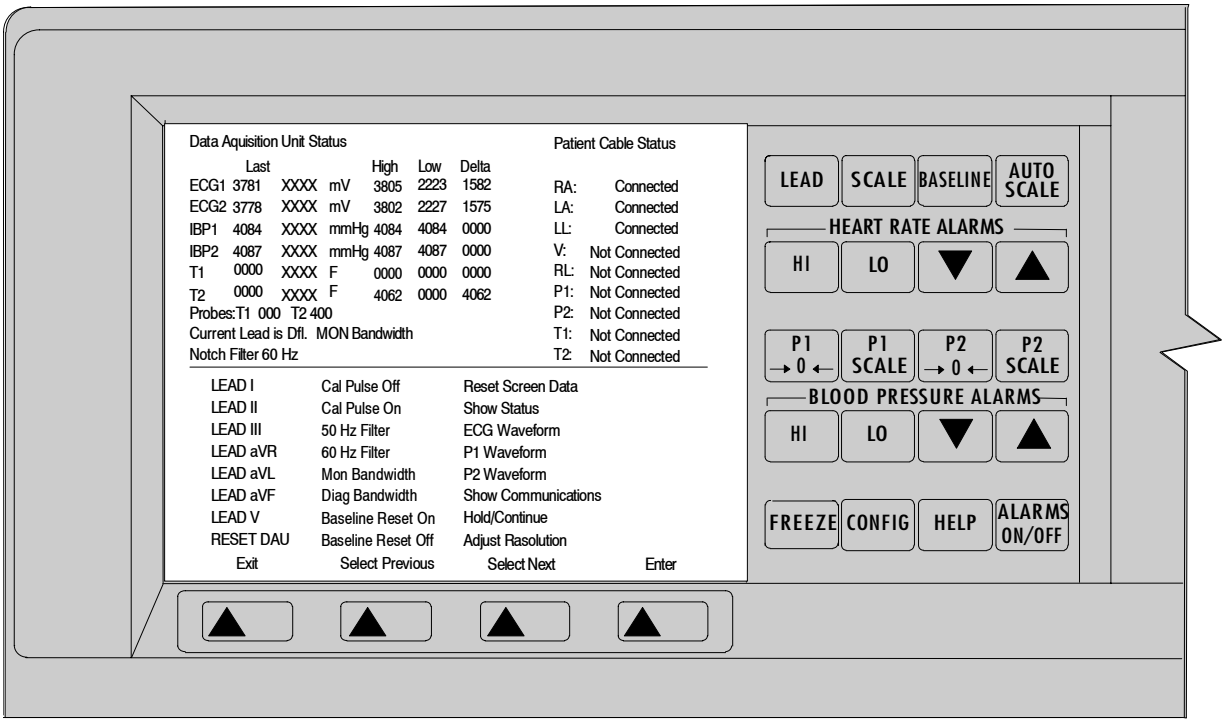

Figure 2-9: DAU TEST SCREEN

2.1.7 DAU Calibration Screen

To access the DAU Calibration Screen, press the SELECT key to advance the cursor to the DAU CALIBRATION option, and then press the ENTER key. This screen is used to calibrate the Data Acquisition Unit which can be calibrated either manually or automatically (see Section 5).

The screen is divided into two parts (see Figure 2-10). The upper half of the screen shows one of seven selectable displays: DAU measurement and status, ECG waveform, P1 waveform, P2 waveform, a communication display, T1 waveform and T2 waveform (T1 and T2 waveforms only on instruments with firmware prior to Version 2.0). The bottom half of the screen contains a list of display and command options which are selected by pressing the SELECT PREVIOUS or SELECT NEXT key (to advance the cursor up or down the option list), followed by the ENTER key.

Table 2-1 at the end of this section lists definitions for the VITALERT 2000 service screen commands.

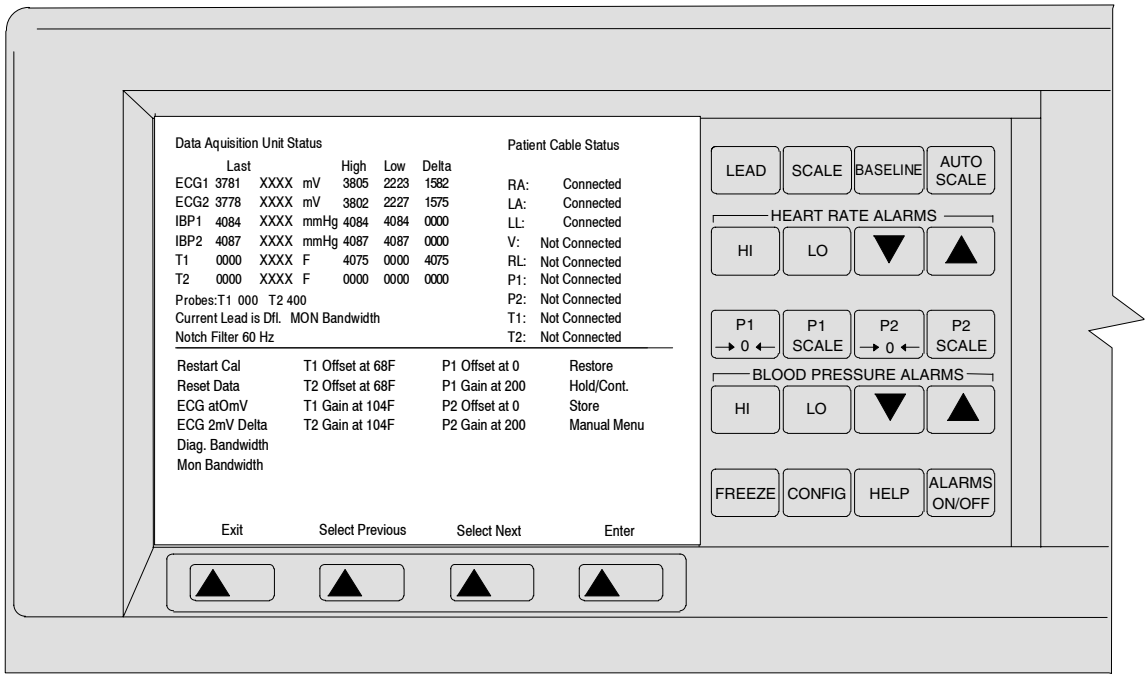

Figure 2-10: DAU CALIBRATION SCREEN

2.1.8 Keyboard Select Screen

To access the Keyboard Select Screen, press the SELECT key to advance the cursor to the KEYBOARD SELECT option, and then press the ENTER key. This screen allows the TSR to alter preset factory defaults for a Type 1 keyboard. The screen shall be accessed and changed when a keyboard is being replaced with a Type 2 keyboard.

The keyboard selection is changed by using the SELECT key to move the cursor to the proper selection, followed by the ENTER key to change the setting. Changing the keyboard selection in the Keyboard Selection Screen automatically changes the keyboard configuration in the Keyboard Test Screen.

NOTE: The TYPE 2 SCR keyboard can only be used on instruments with Version 2.0 firmware or higher.

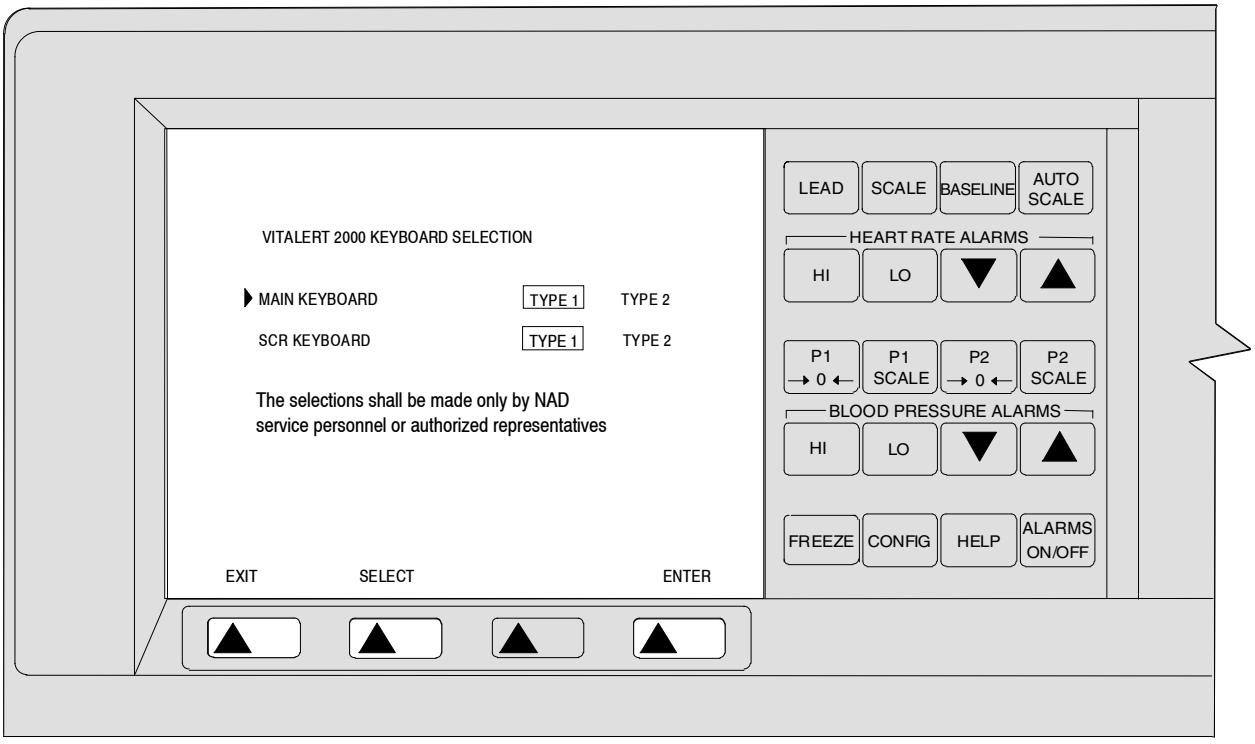

Figure 2-11: KEYBOARD SELECT SCREEN

Table 2-1: VITALERT 2000 SERVICE SCREEN COMMAND DEFINITIONS

COMMAND	DEFINITION
Adjust Resolution	Changes the displayed resolution of the selected waveform
Auto Menu	Invokes the Automatic Calibration screen
Baseline Reset Off	Disables the ECG waveform baseline reset
Baseline Reset On	Enables the ECG waveform baseline reset
Cal Pulse Off	Disables the 1 mV ECG calibration pulse
Cal Pulse On	Enables the 1 mV ECG calibration pulse
Diag Bandwidth	Selects the ECG diagnostic bandwidth
DEC Value	Decrements the selected calibration parameter
ECG Gain Cal	Enables an ECG waveform gain calibration
ECG Offset Cal	Enables an ECG waveform offset calibration
ECG Waveform	Selects a visual display of the ECG waveform
Hold/Cont	Freezes/Unfreezes the current display signals for the Show Communications and Show Status displays
INC Value	Increments the selected calibration parameter
Lead aVF	Selects ECG lead aVF
Lead aVL	Selects ECG lead aVL
Lead aVR	Selects ECG lead aVR
Lead I	Selects ECG lead I
Lead II	Selects ECG lead II
Lead III	Selects ECG lead III
Lead V	Selects ECG lead V
Mon Bandwidth	Selects ECG monitoring bandwidth
P1 Gain Cal	Enables a P1 gain calibration

Table 2-1 (continued): VITALERT 2000 SERVICE SCREEN COMMAND DEFINITIONS

COMMAND	DEFINITION
P1 Offset Cal	Enables a P1 offset calibration
P1 Waveform	Selects a visual display of the P1 waveform
P2 Gain Cal	Enables a P2 gain calibration
P2 Offset Cal	Enables a P2 offset calibration
P2 Waveform	Selects a visual display of the P2 waveform
Re-Init Value	Resets the selected calibration gain value to 1 or the selected calibration offset value to 0
Reset (Screen) Data	Resets the screen data
Reset DAU	Applies a hardware reset to the DAU
Restart Cal	Restarts the calibration of the currently selected signal
Restore	Copies all of the last stored calibration values stored in the EEPROM to RAM for use in a new calibration
Show Communications	Displays actual communication packets between the DAU and the VITALERT 2000 main board
Show Status	Displays the current data values for ECG,pressure, and temperature
Store	Stores all offset and gain calibration values completed
T1 Gain Cal	Enables a T1 gain calibration
T1 Offset Cal	Enables a T1 offset calibration
T1 Waveform	Selects a visual display of the T1 waveform
T2 Gain Cal	Enables a T2 gain calibration
T2 Offset Cal	Enables a T2 offset calibration
T2 Waveform	Selects a visual display of the T2 waveform
50 Hz Filter	Selects the ECG 50 Hz notch filter
60 Hz Filter	Selects the ECG 60 Hz notch filter

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3.0 TROUBLESHOOTING

This section contains information to assist the Technical Service Representative in locating electrical faults affecting the VITALERT 2000 monitoring and display devices. Since most troubleshooting efforts begin with verifying power supply voltages, the following paragraph outlines the voltage distribution scheme within the instrument along with cable connector identification.

3.1 Power Supply and Voltage Distribution

Figure 3-1 shows a block diagram of the voltage distribution within the VITALERT 2000 from the power supply PCB assembly. Voltages at power supply connector pins are given in Table 3-1 along with their allowable tolerances.

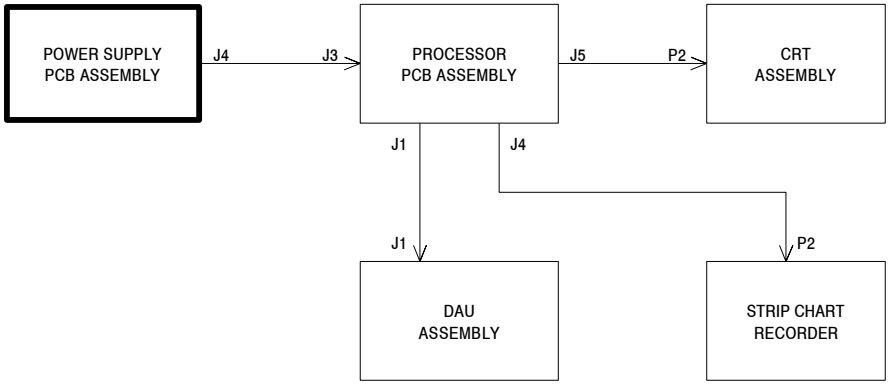


Figure 3-1: VITALERT 2000 VOLTAGE DISTRIBUTION

WARNING: Hazardous voltages exist inside the VITALERT 2000 cabinet. Observe appropriate safety precautions when servicing the instrument. High voltage exists at the CRT even when AC power is disconnected.

Refer to Section 4 of this manual for appropriate removal and replacement procedures.

Table 3-1: POWER SUPPLY VOLTAGES

CONNECTOR PIN	NOMINAL VOLTAGE WITH RESPECT TO COMMON	ACCEPTABLE RANGE
J4-2	+12 CRT	+11.21 to +12.21
J4-3	+12 SCR	+11.21 to +12.21
J4-5	+5 Logic	+4.85 to +5.25
J4-6	+5 Unswitched	+4.75 to +5.25
J4-1 Common		

3.2 Battery

At full charge (instrument plugged into a live AC outlet for ≥16 hours) the battery voltage should be ≥18.0 VDC. The battery voltage is measured at the black and orange wires from the battery pack, with J3 disconnected.

The battery charging voltage is measured between J3-2 (+) and J3-1 (-) on the power supply PCB assembly. With AC power applied and J3 disconnected, the charging voltage should be ≥19.0 VDC with the VITALERT 2000 in STBY or ON.

During battery operation, the low battery cutoff voltage should be within the range of 13.6 to 15.6 VDC.

3.3 Error Log Messages

Table 3-2 lists the possible fail events that can be logged into the memory of the VITALERT 2000. Each message is keyed to a troubleshooting guide flow chart or procedure to assist the Technical Service Representative (TSR) in locating a problem.

These messages will appear on the ERROR LOG screen found in the Service Diagnostics menu (see "Entering Service Diagnostics" for instructions on entering the Service Menu) and are often directly associated with a FAIL message appearing during the power up SELF DIAGNOSTICS test. Each message is preceded by the time and date of the error. Most of the listings here can be traced to problems with the processor PCB assembly. When these errors are intermittent, AC power line surges or loose cable connections can be the problem. Be sure to examine the SYSTEM STATUS SCREEN to check for such problems before removing any module.

TABLE 3-2: ERROR LOG MESSAGES

ERROR LOG MESSAGE	RECOMMENDED ACTION
A/D CONVERTER FAIL	GUIDE 6
AUDIO CIRCUIT FAIL	GUIDE 7
BACKUP MEMORY FAIL	GUIDE 10
BACKUP SPEAKER FAIL	GUIDE 7
bad Free_Seg	PROCEDURE 4.2
bad Alloc_Seg	PROCEDURE 4.2
Bad DAU Checksum	PROCEDURES 4.2, 4.5
BAD Time CLOCK	PROCEDURE 4.2
BAD FONT SET	PROCEDURE 4.2
BATTERY DISCONNECT	GUIDE 12
CIRCUIT BREAKER OPEN	GUIDE 12
CONFIG EVENT NOT RECOGNIZED	PROCEDURE 4.2
DATA Didnt SPAWN	PROCEDURE 4.2

TABLE 3-2: ERROR LOG MESSAGES (continued)

ERROR LOG MESSAGE	RECOMMENDED ACTION
DAU Didnt Communicate	PROCEDURES 4.5, 4.2
DAU Power Up Test Failure	PROCEDURES 4.5, 4.2
DAU Calibration Error	PROCEDURES 4.5, 4.2
DAU Stopped Responding	PROCEDURE 5.2
DAUC Didnt Activate	PROCEDURE 4.5
DISP Didnt SPAWN	PROCEDURE 4.2
DTST Didnt Activate	PROCEDURE 4.2
FIRMWARE FAIL	PROCEDURE 4.2
LEAD sequence	PROCEDURE 4.2
Lower Window Creation Error	GUIDE 3
Main SPEAKER FAIL	PROCEDURES 4.2, 4.5
MFP 5ms TIMER FAIL	PROCEDURE 4.2
MFP BUS FAIL	GUIDE 7
MFP 10 ms TIMER FAIL	GUIDE 5
NO TIME	GUIDE 5
NOT CONFIGDN EVENT	GUIDE 5
PRS1 Didnt Activate	PROCEDURE 4.2
PRS1 Didnt SPAWN	PROCEDURE 4.2
PRS2 Didnt SPAWN	PROCEDURE 4.2
PRSK Didnt Activate	PROCEDURE 4.2
RAM LOWEST BYTE FAIL	PROCEDURE 4.2
RAM M-LOW BYTE FAIL	PROCEDURE 4.2
RAM M-HIGH BYTE FAIL	GUIDE 4
RAM HIGH BYTE FAIL	GUIDE 4
REAL TIME CLOCK FAIL	GUIDE 4
ROM CRC	GUIDE 4
ROM Memory Failure	GUIDE 9

TABLE 3-2: ERROR LOG MESSAGES (continued)

ERROR LOG MESSAGE	RECOMMENDED ACTION
SOFTWARE EXCEPTION	PROCEDURE 4.2
start cal mode	PROCEDURE 4.2
stop_cal	PROCEDURE 4.2
stop_comm	PROCEDURE 4.2
TRAX Too Many Messages	PROCEDURE 4.2
TRAX CREATE ERROR	PROCEDURE 4.2
TRAX Unusable	PROCEDURE 4.2
UART MFP COMM FAIL	PROCEDURE 4.2
UART DAU RX INT FAIL	PROCEDURE 4.2
UART SIO PORT FAIL	GUIDE 8
UART PORT A FAIL	GUIDE 8
UART PORT B FAIL	GUIDE 8
UART PORT C FAIL	GUIDE 8
UART PORT D FAIL	GUIDE 8
UART PORT E FAIL	GUIDE 8
UART PORT F FAIL	GUIDE 8
UART PORT G FAIL	GUIDE 8
UART PORT H FAIL	GUIDE 8
Unspecified DAU Error	PROCEDURES 4.5, 4.2
Upper Window Creation Error	PROCEDURE 4.2
VID CONTROLLER FAIL	GUIDE 2
VRAM HIGH NIBLE FAIL	GUIDE 2
VRAM LOW NIBLE FAIL	GUIDE 2
WD TIMEOUT	PROCEDURE 4.2
write failed	PROCEDURE 4.2
write cal quit	PROCEDURE 4.2

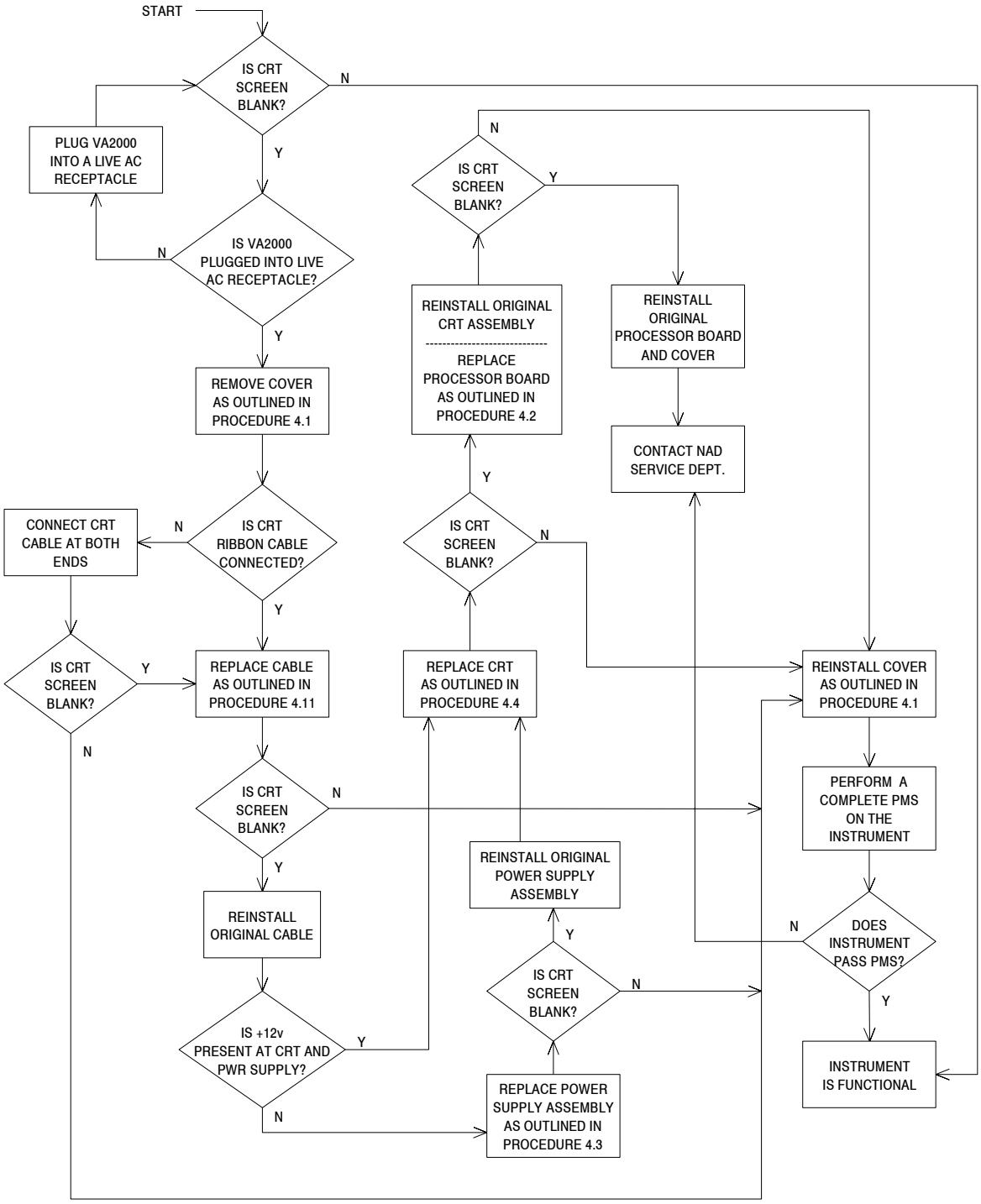
3.4 Troubleshooting Guides

The Troubleshooting Guides given on the following pages will aid the TSR in correcting problems that may occur in the VITALERT 2000. If a problem occurs that cannot be corrected by following these guides, call the NAD Technical Service Department for support.

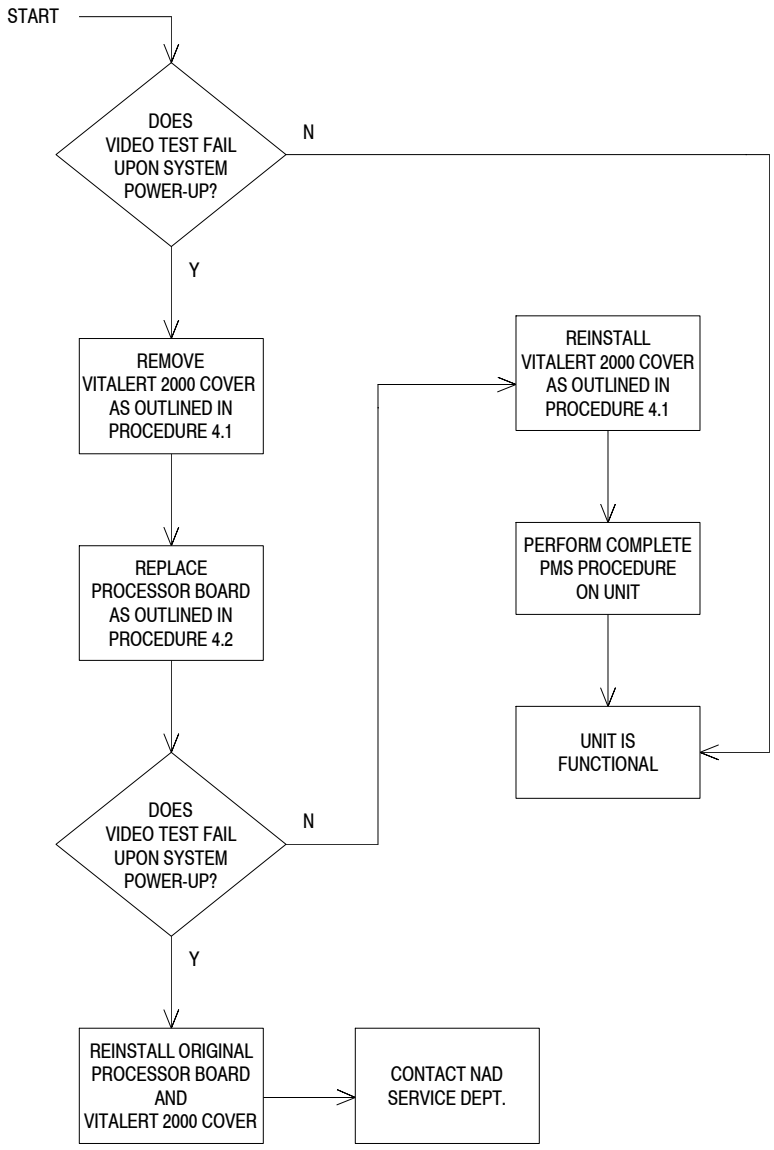
List of Guides:

List of Guides (continued):

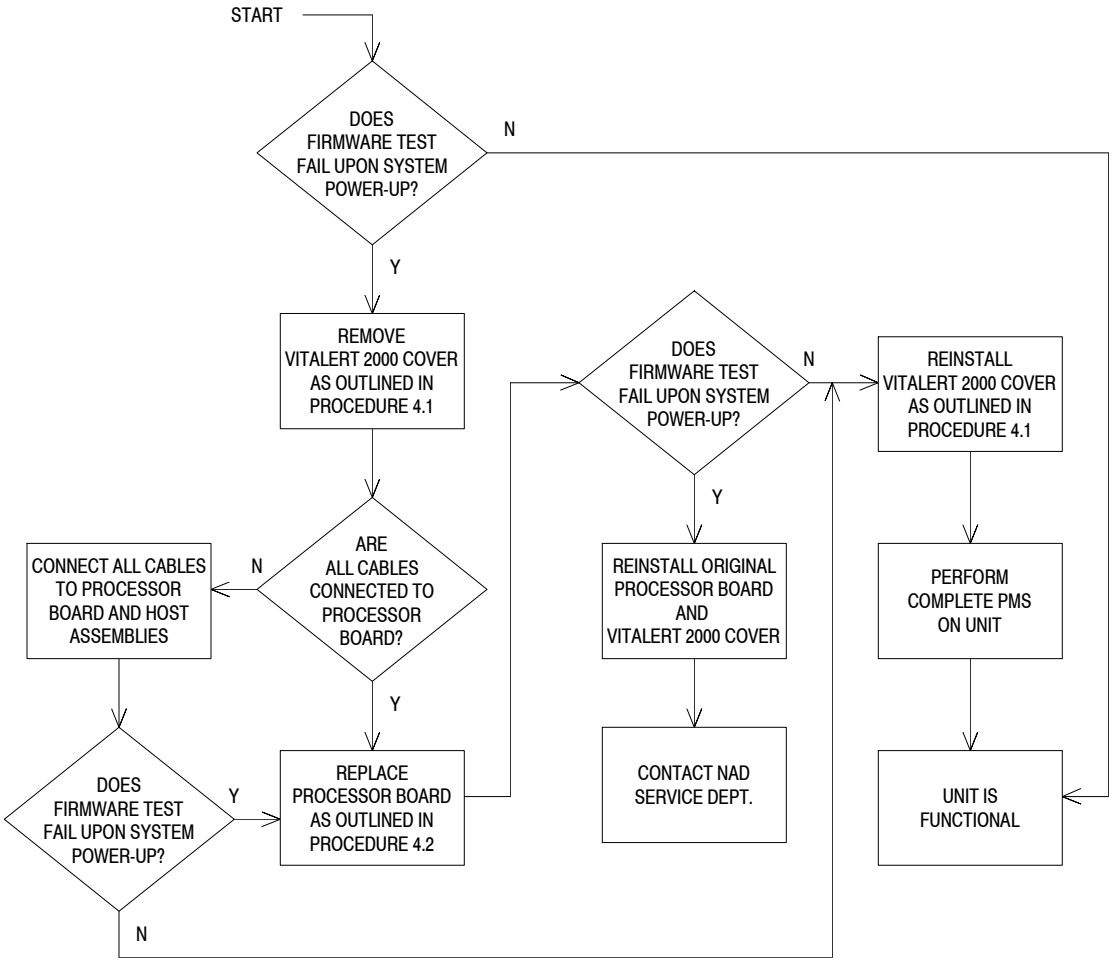
GUIDE 1: CRT blank upon system power-up



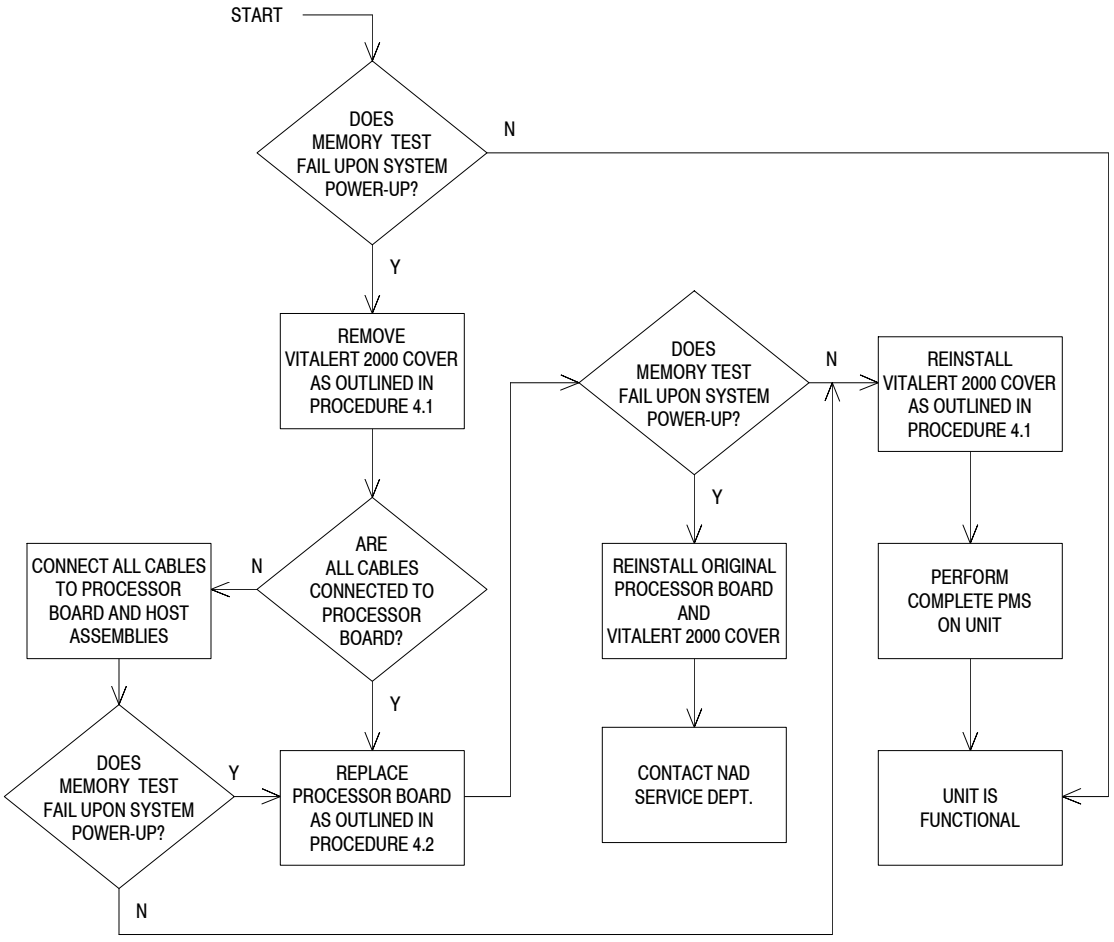
GUIDE 2: VIDEO TEST fails upon system power-up



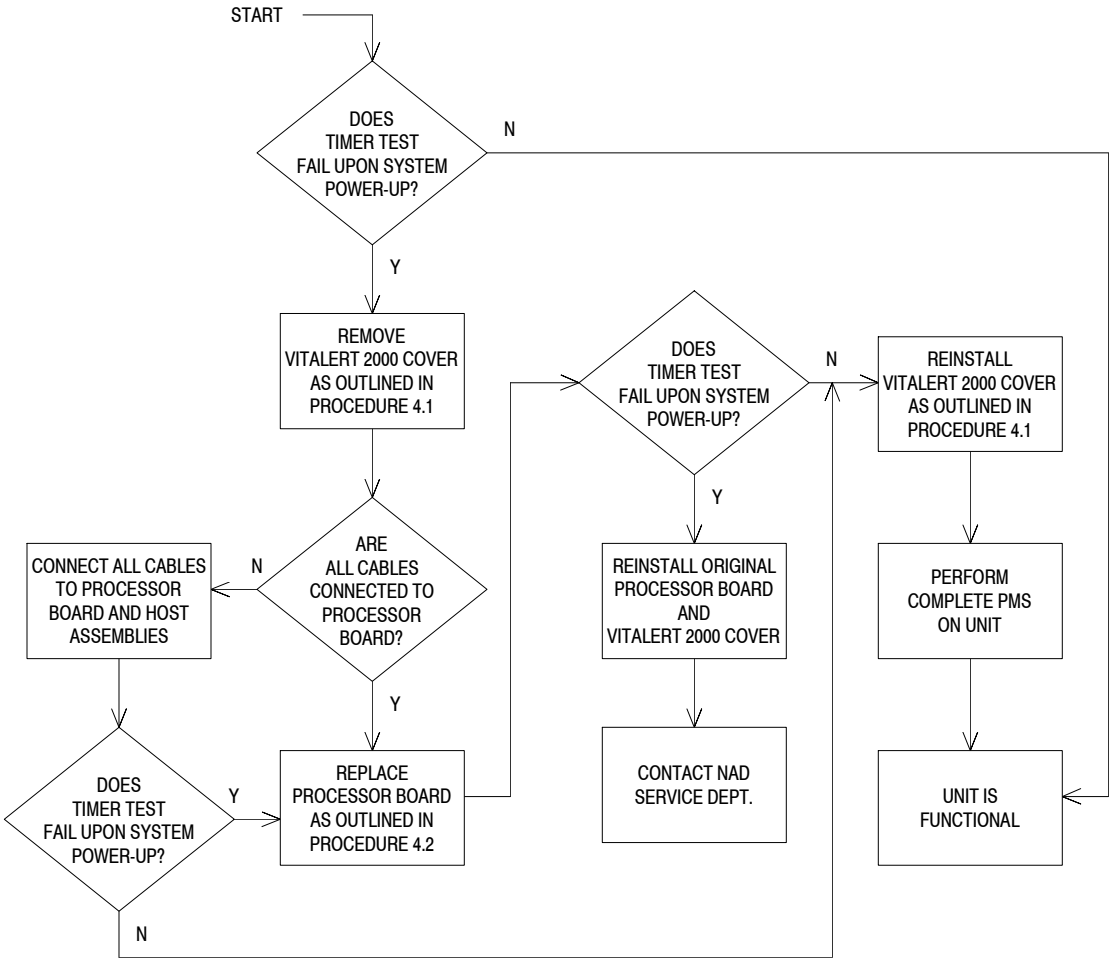
GUIDE 3: FIRMWARE TEST fails upon system power-up



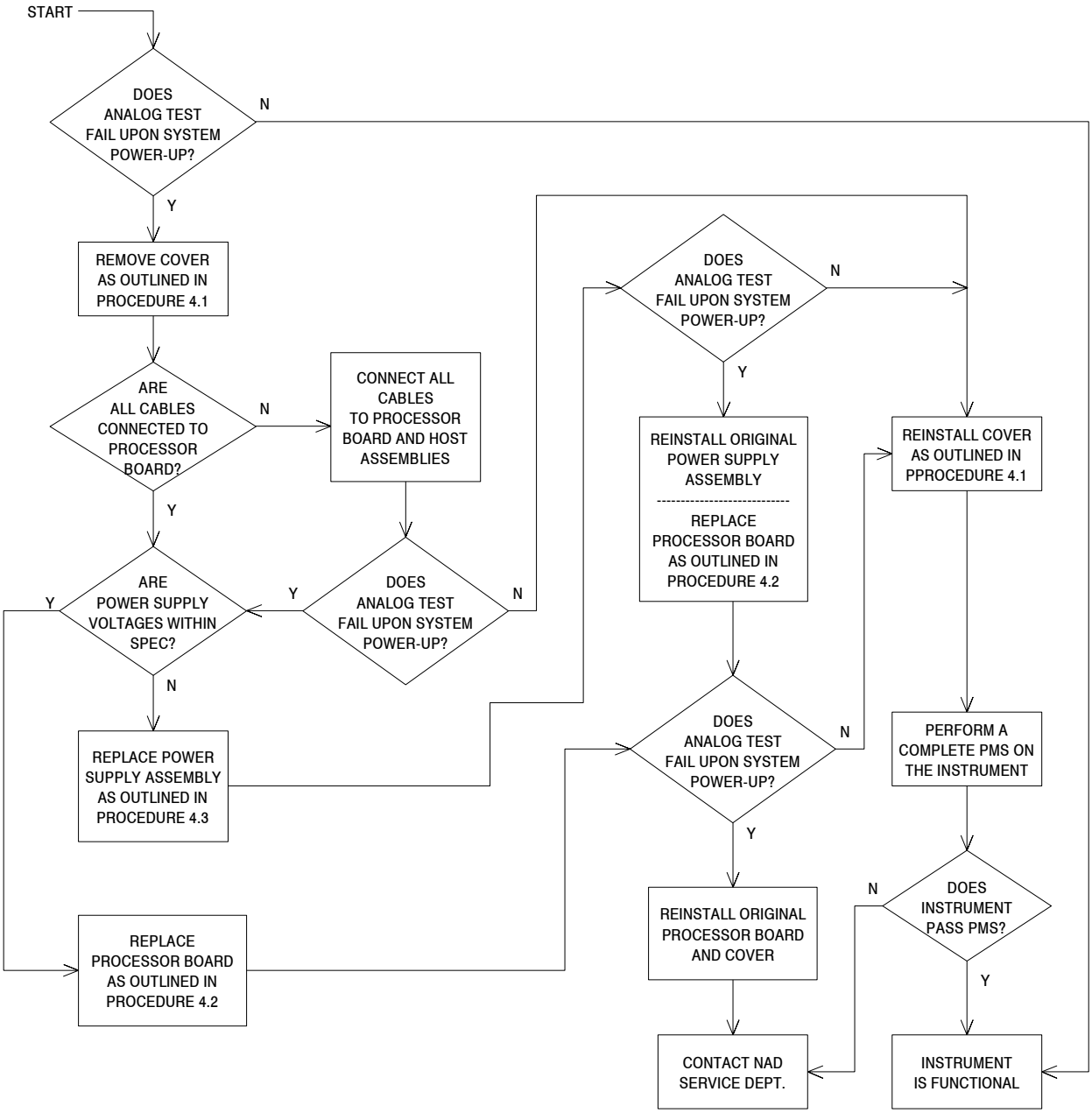
GUIDE 4: MEMORY TEST fails upon system power-up



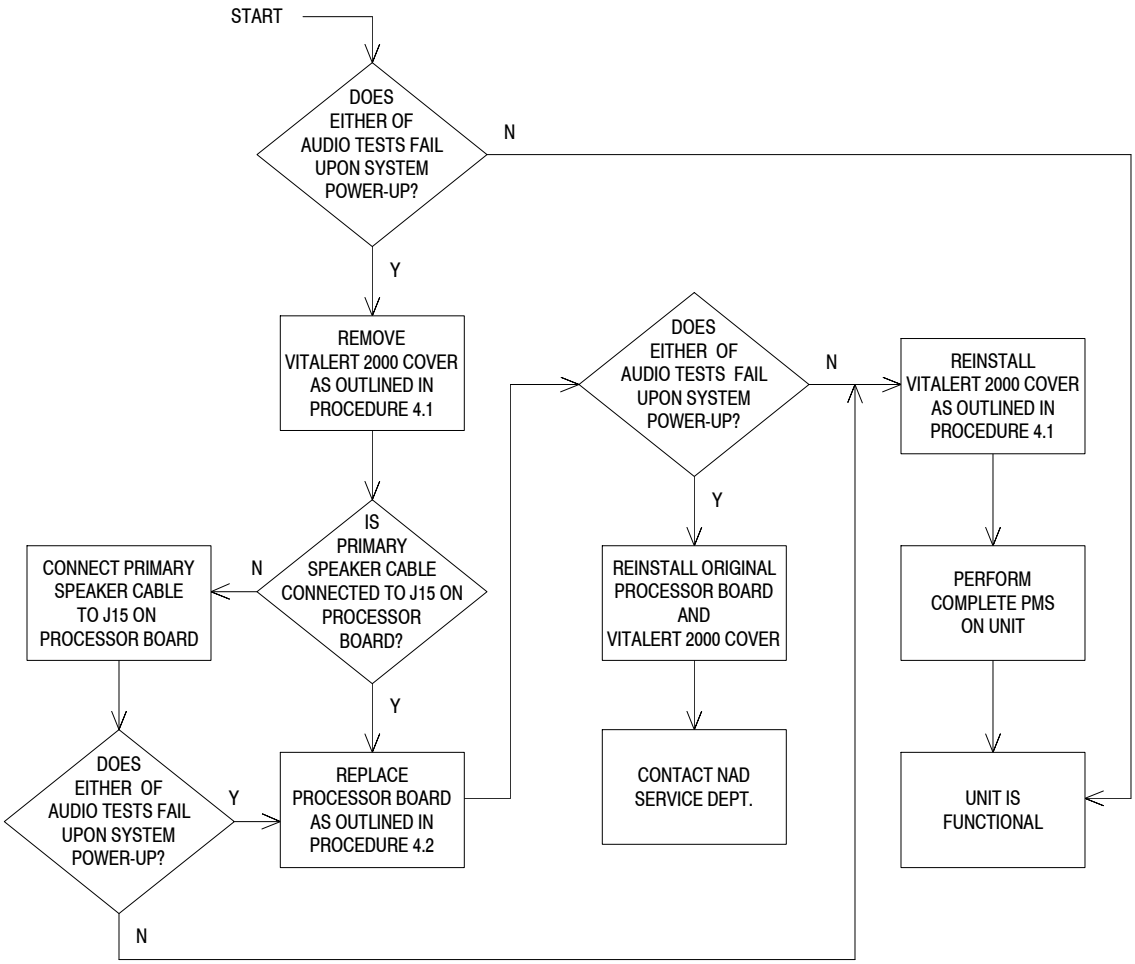
GUIDE 5: TIMER TEST fails upon system power-up



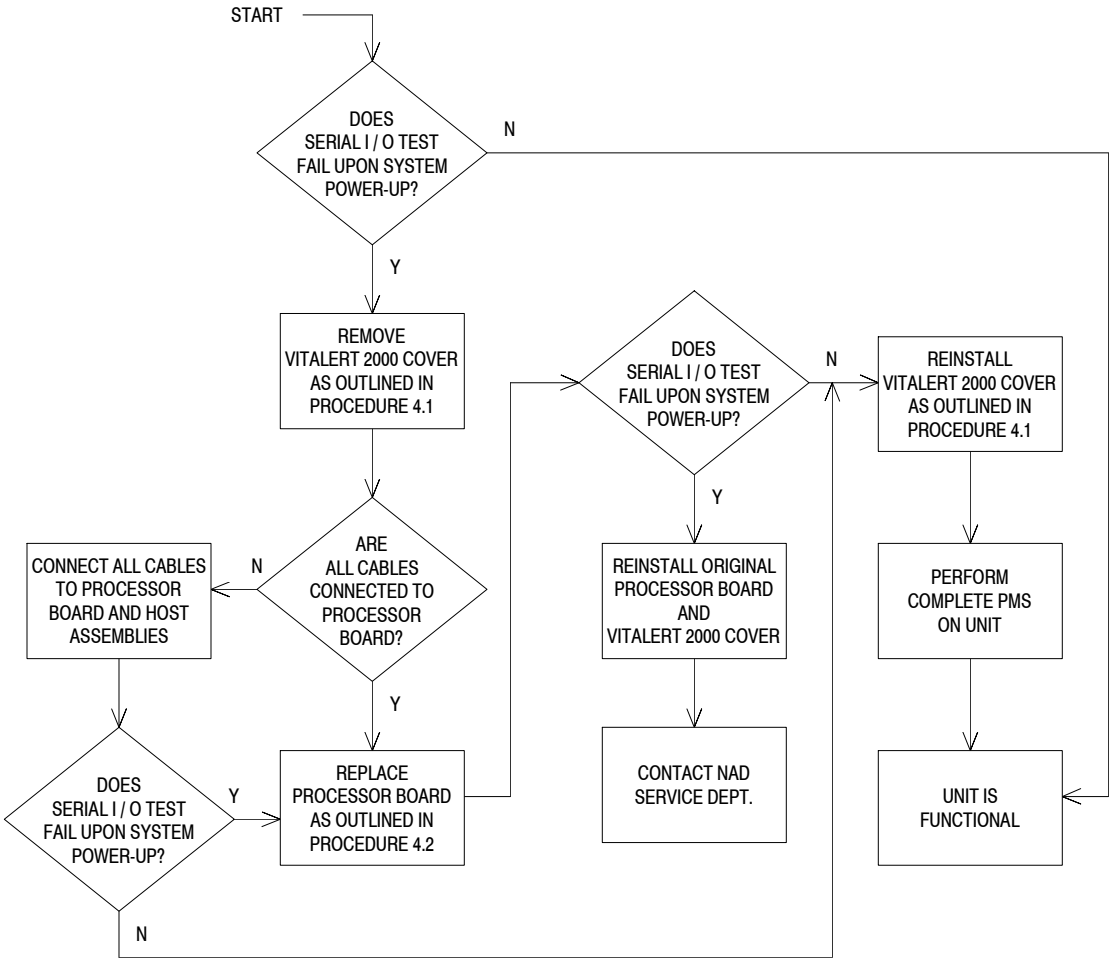
GUIDE 6: ANALOG TEST fails upon system power-up



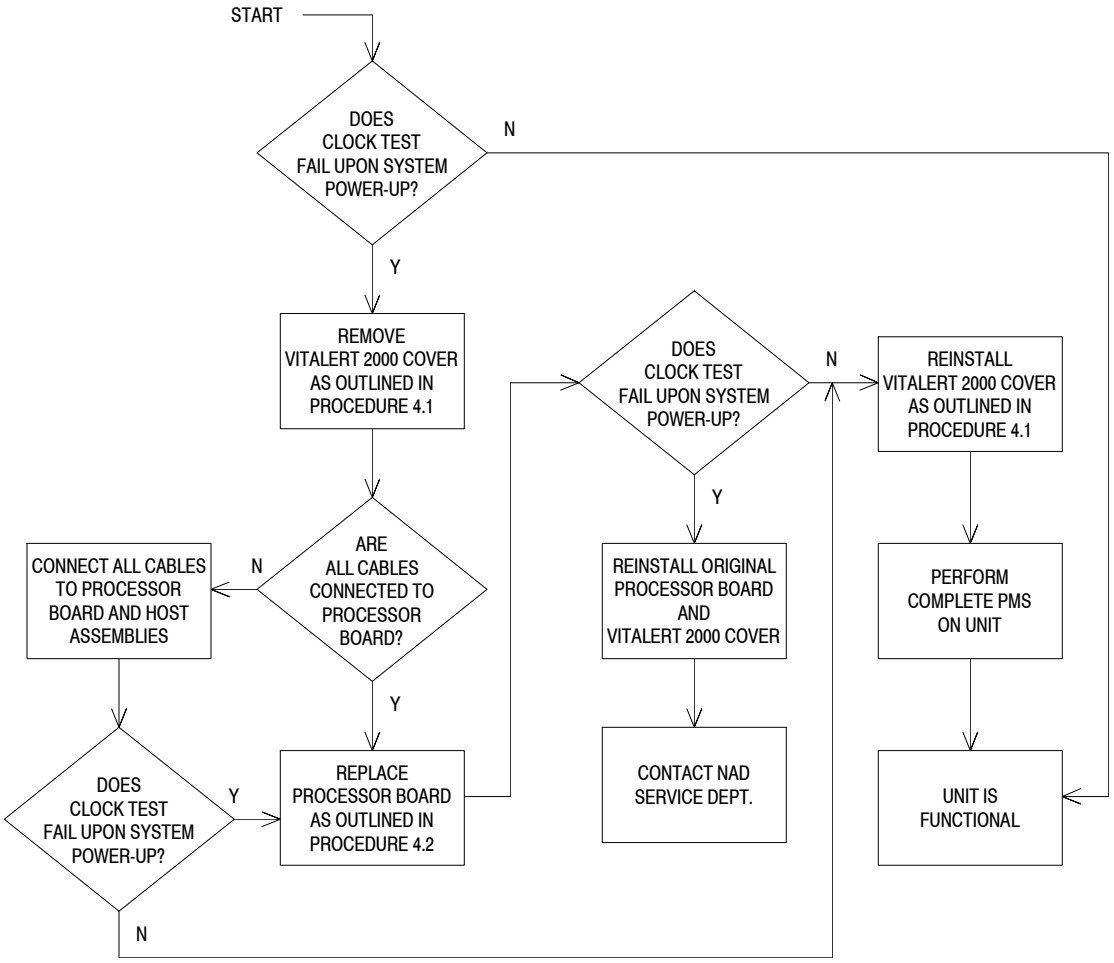
GUIDE 7: AUDIO TEST - PRIMARY or BACKUP fails upon system power-up



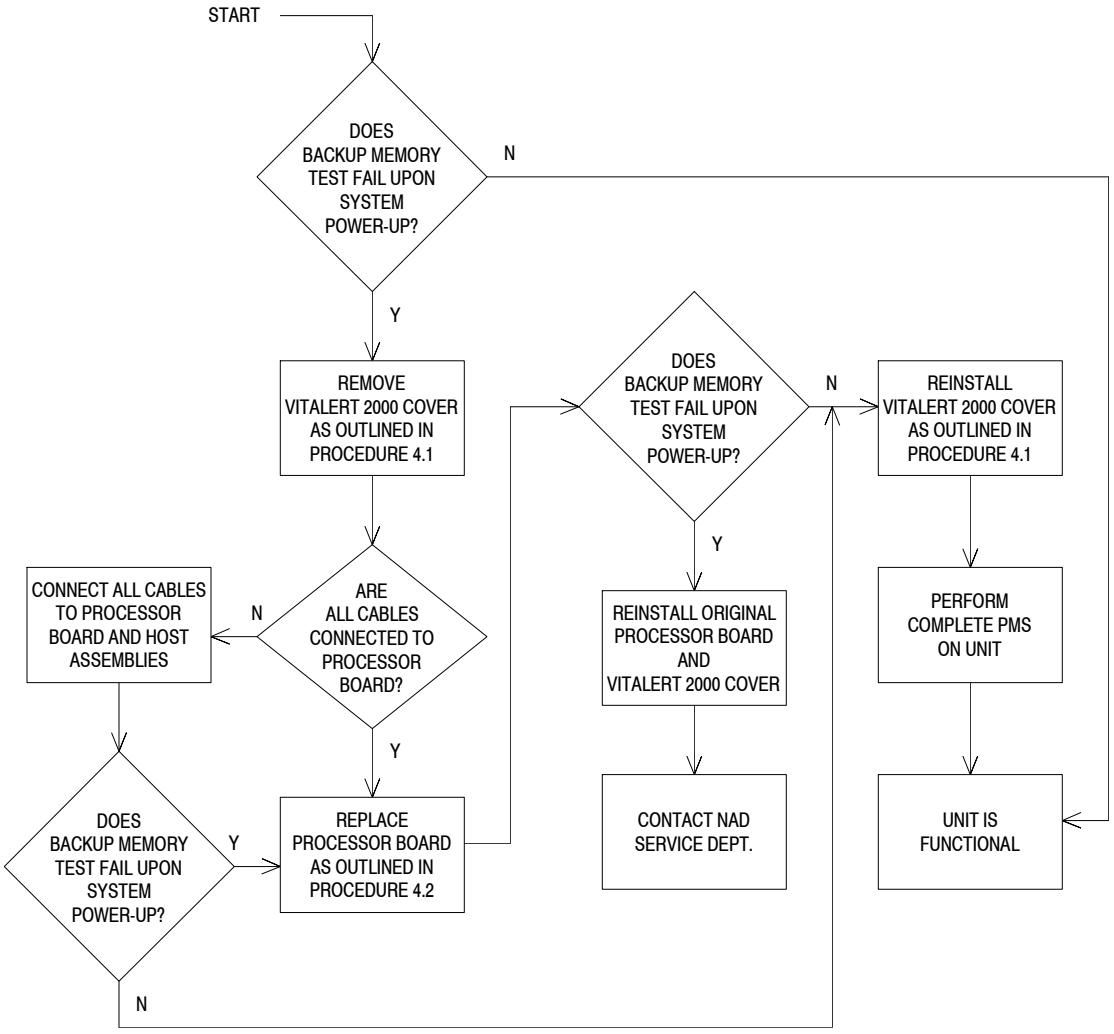
GUIDE 8: SERIAL I/O TEST fails upon system power-up



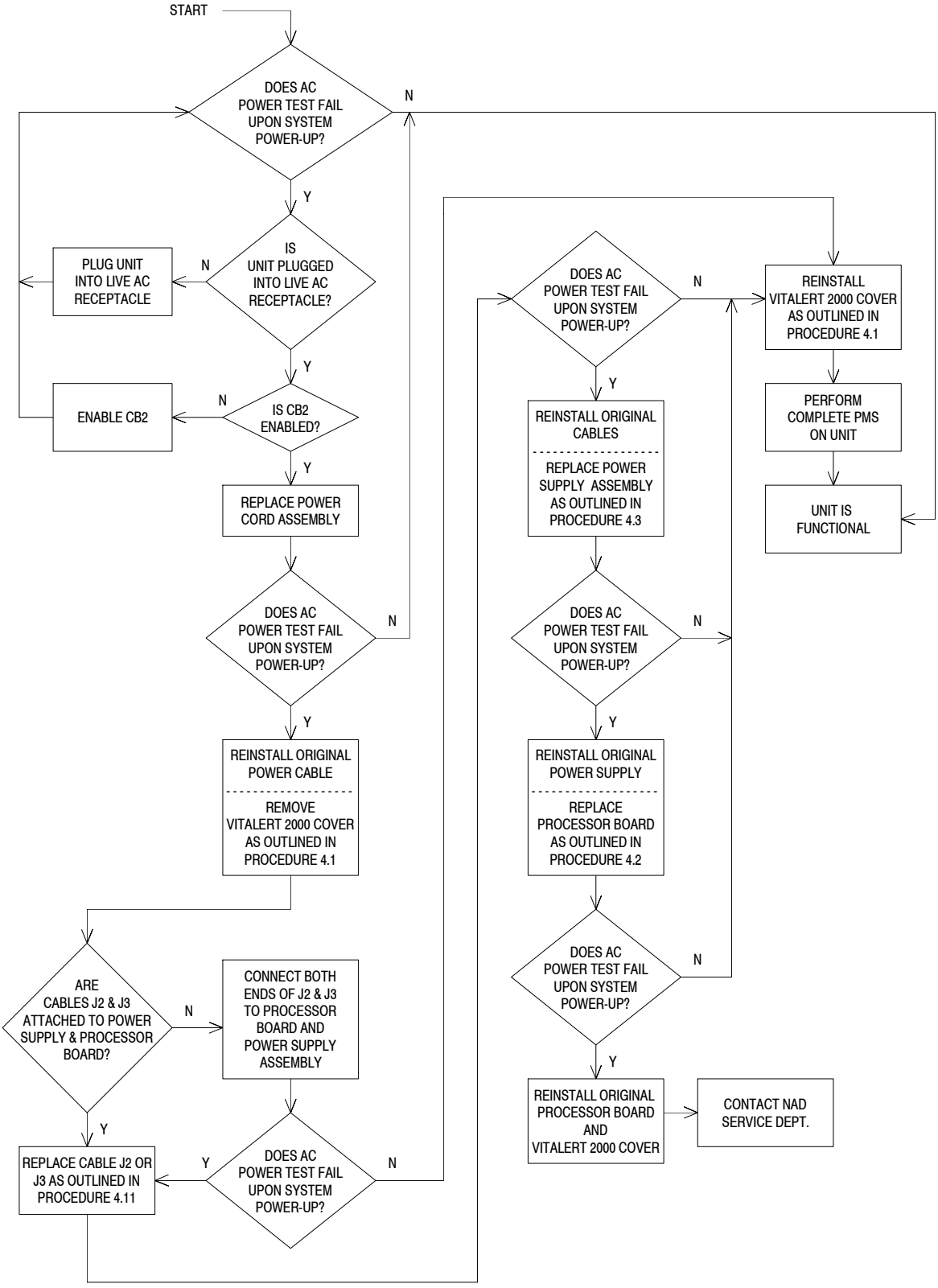
GUIDE 9: CLOCK TEST fails upon system power-up



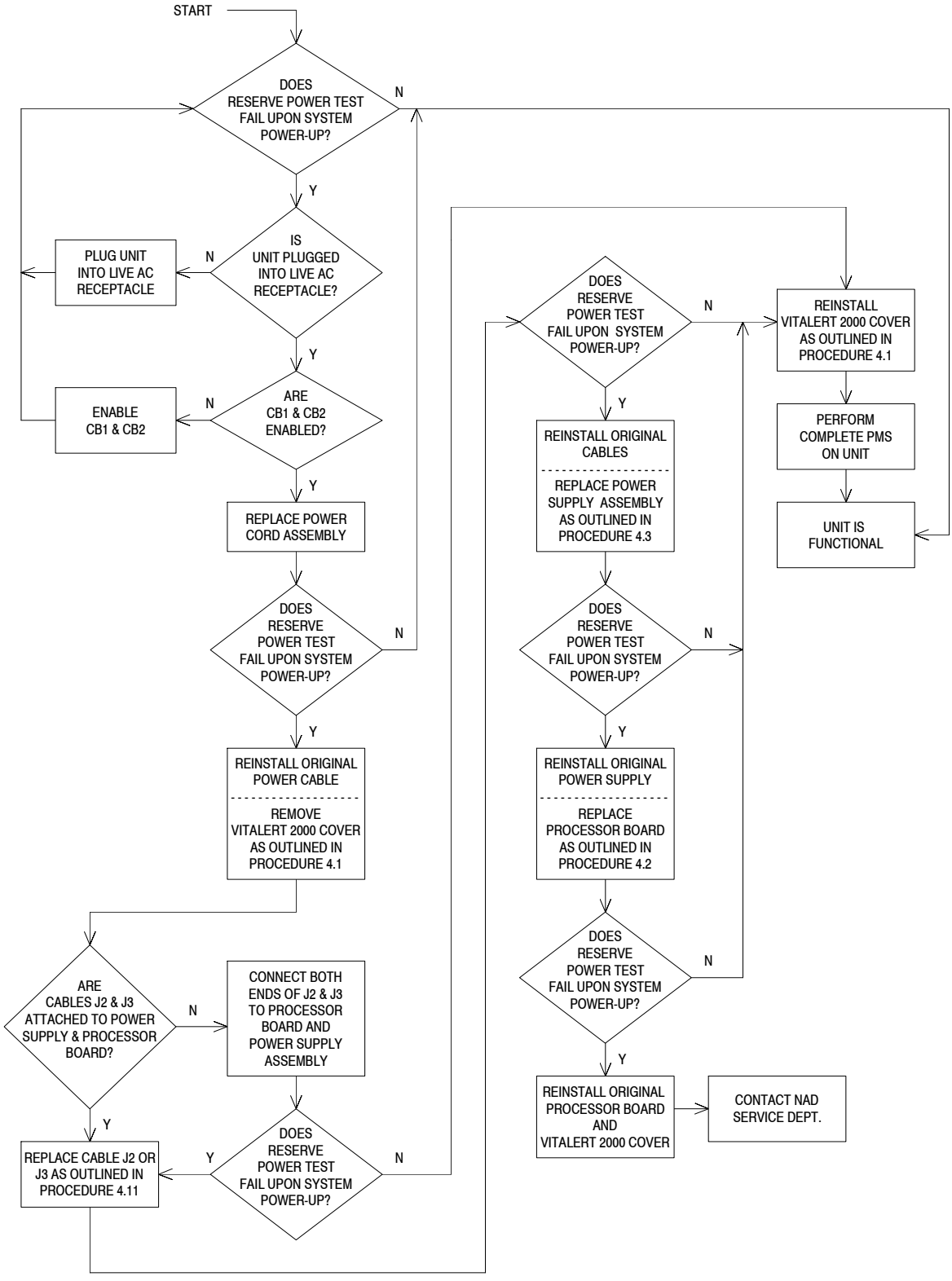
GUIDE 10: BACKUP MEMORY TEST fails upon system power-up



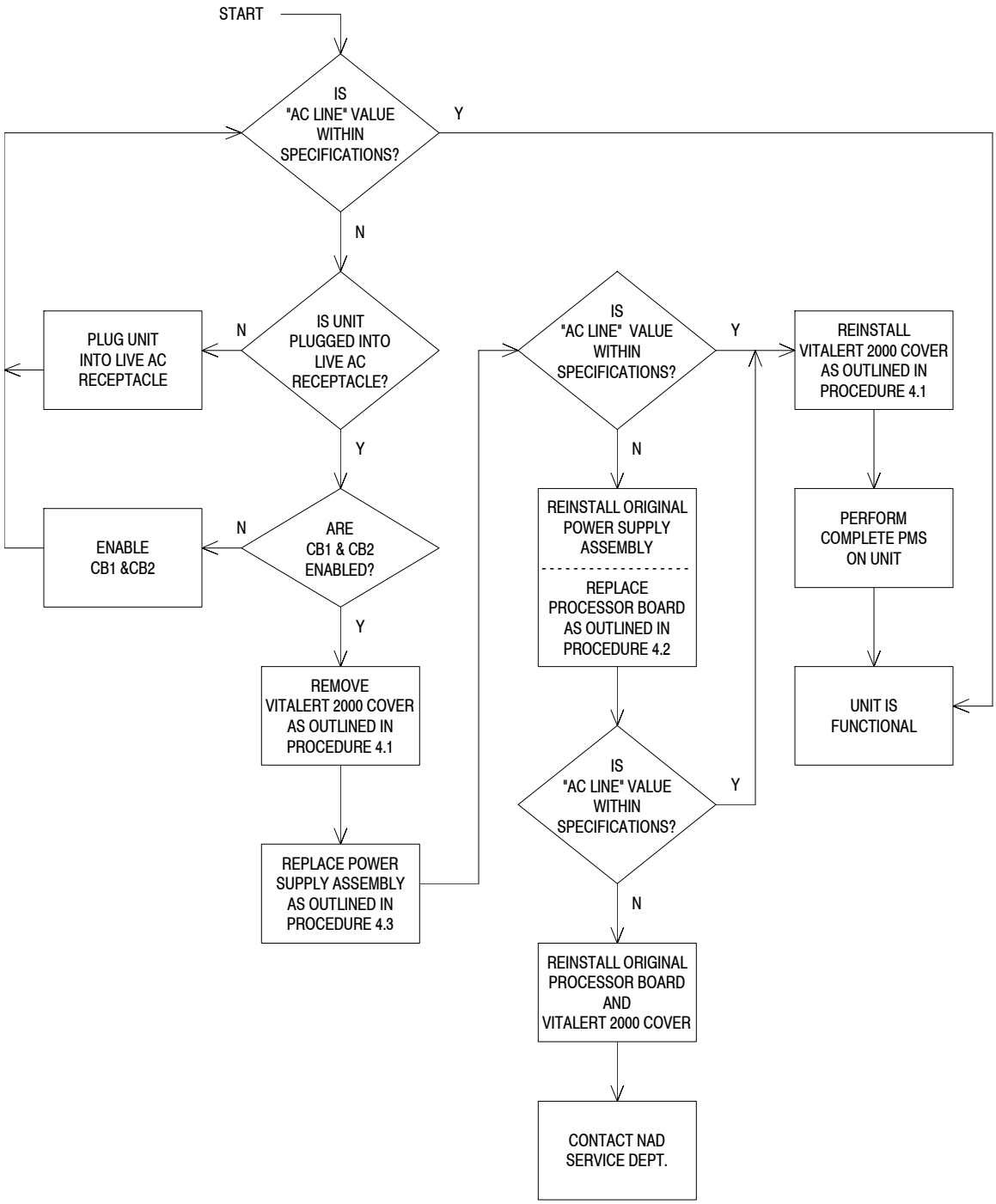
GUIDE 11: AC POWER TEST fails upon system power-up



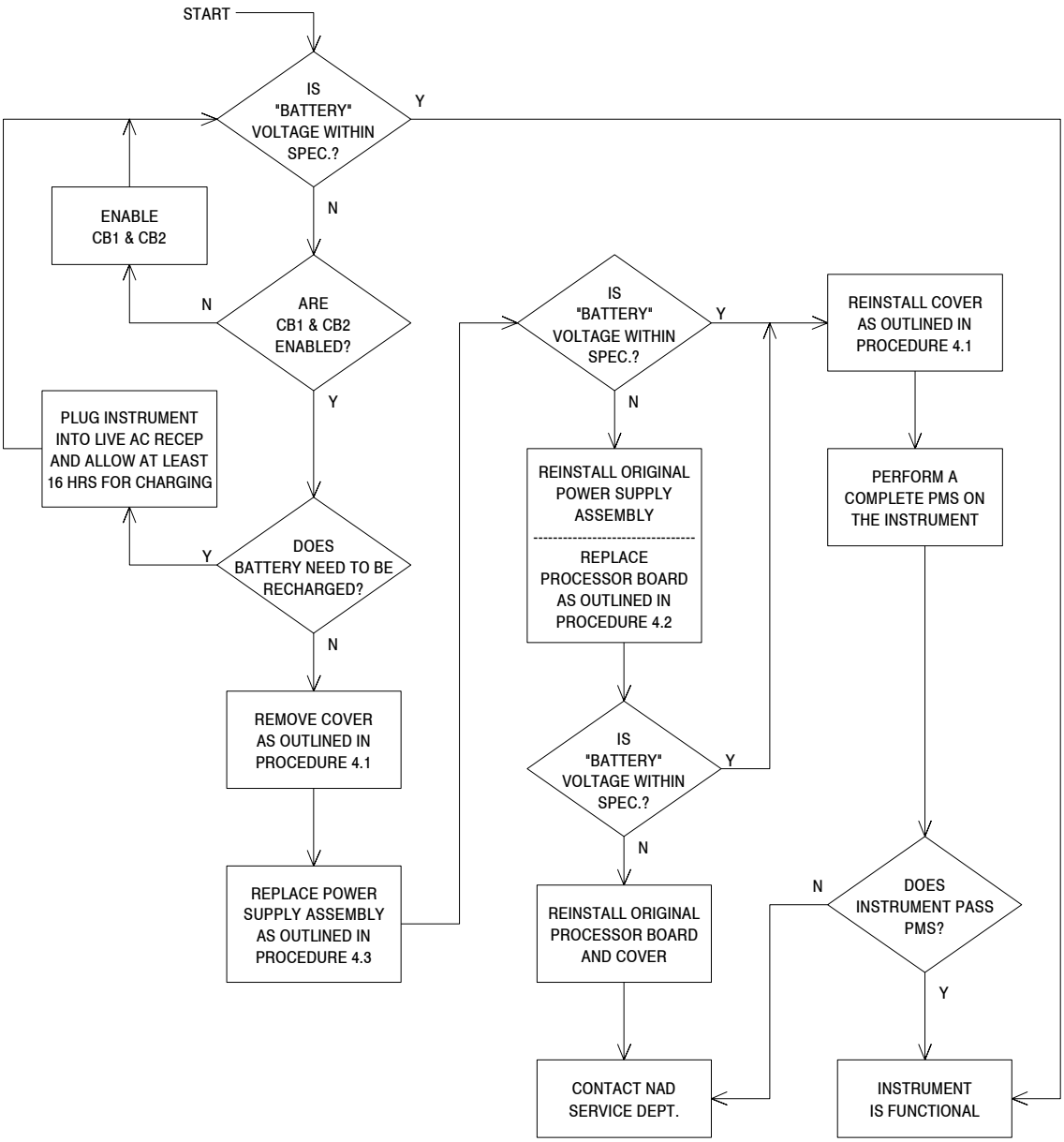
GUIDE 12: RESERVE POWER TEST fails upon system power-up



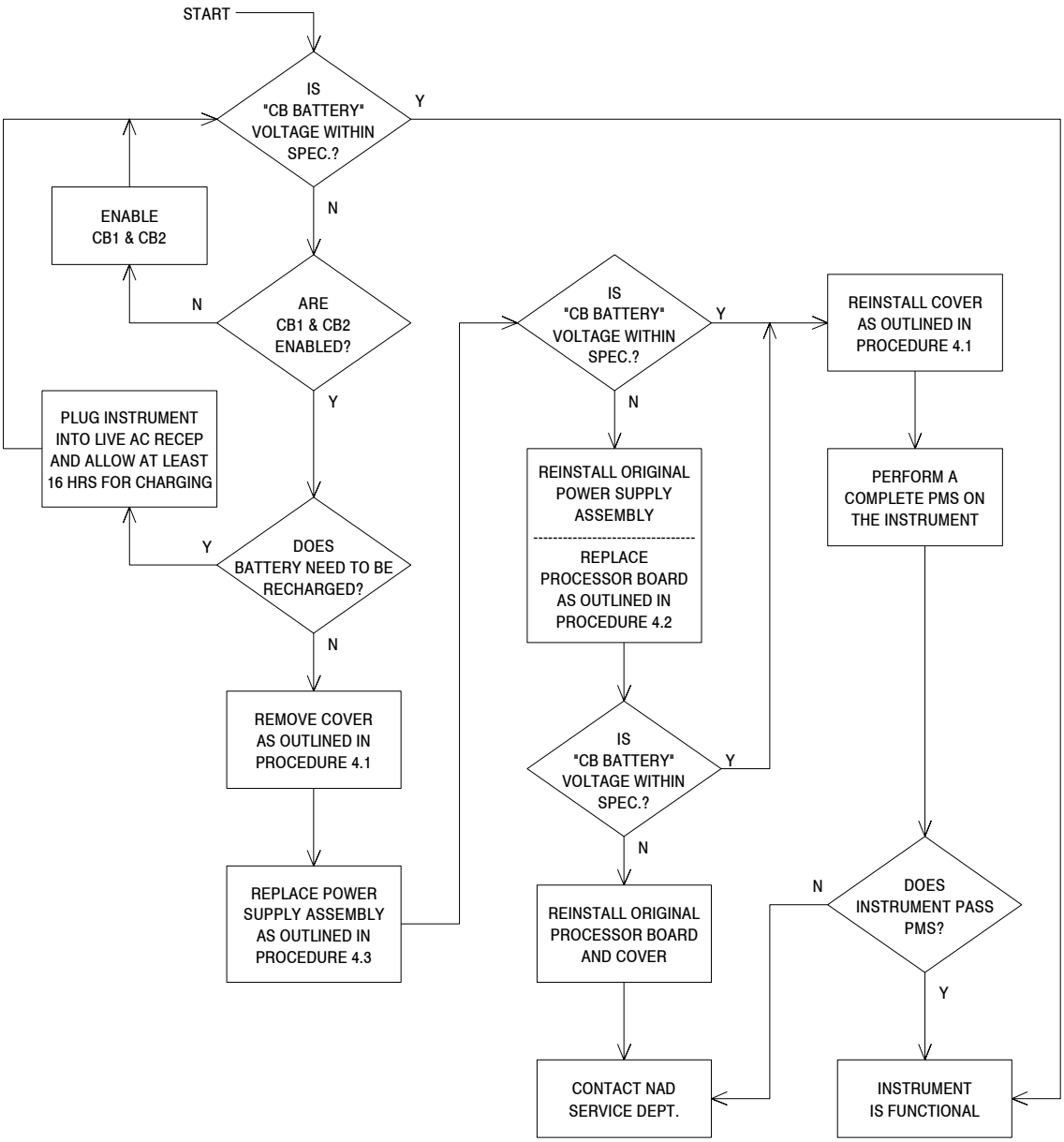
GUIDE 13: AC LINE value is not within specifications



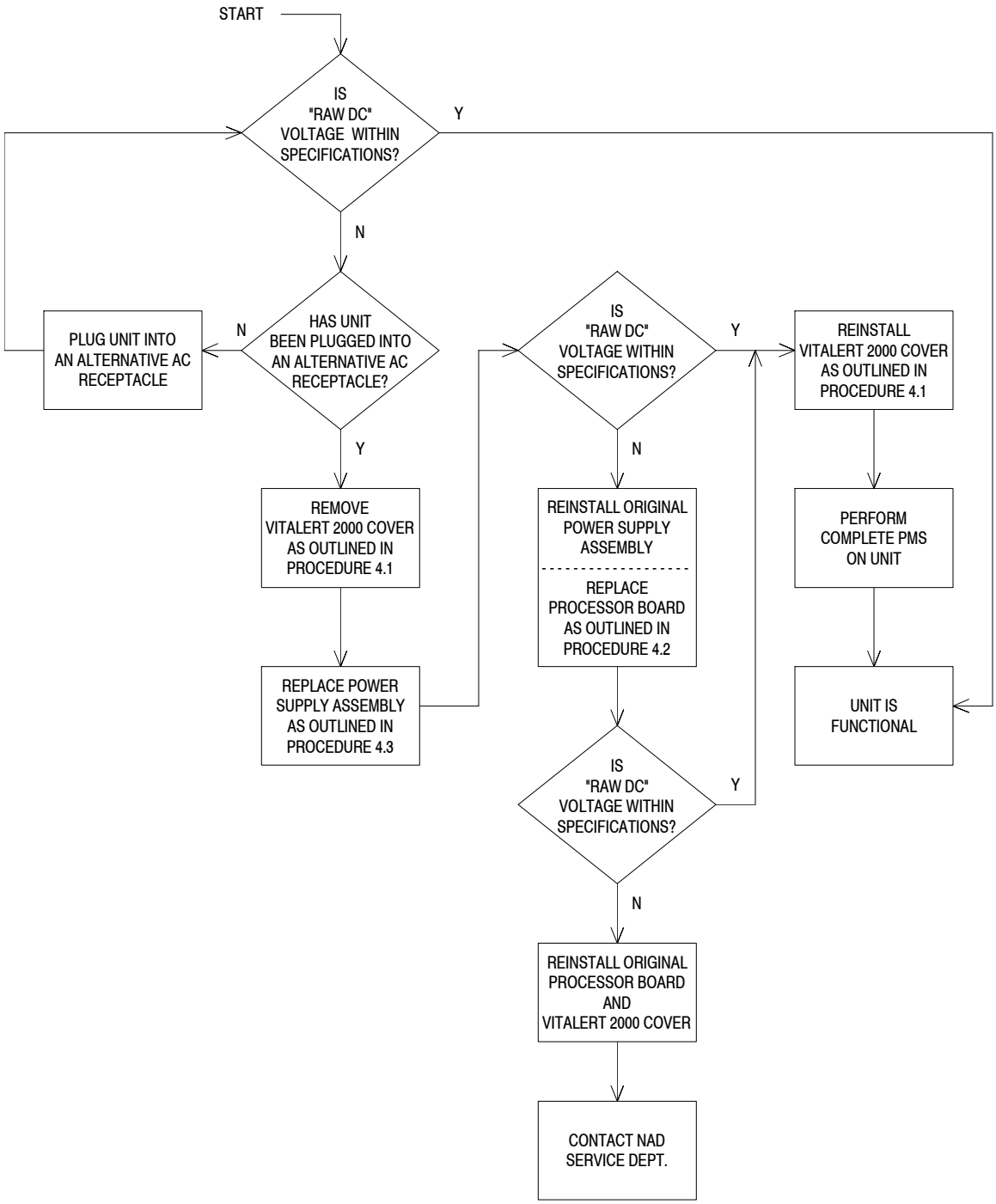
GUIDE 14: BATTERY voltage is not within specifications



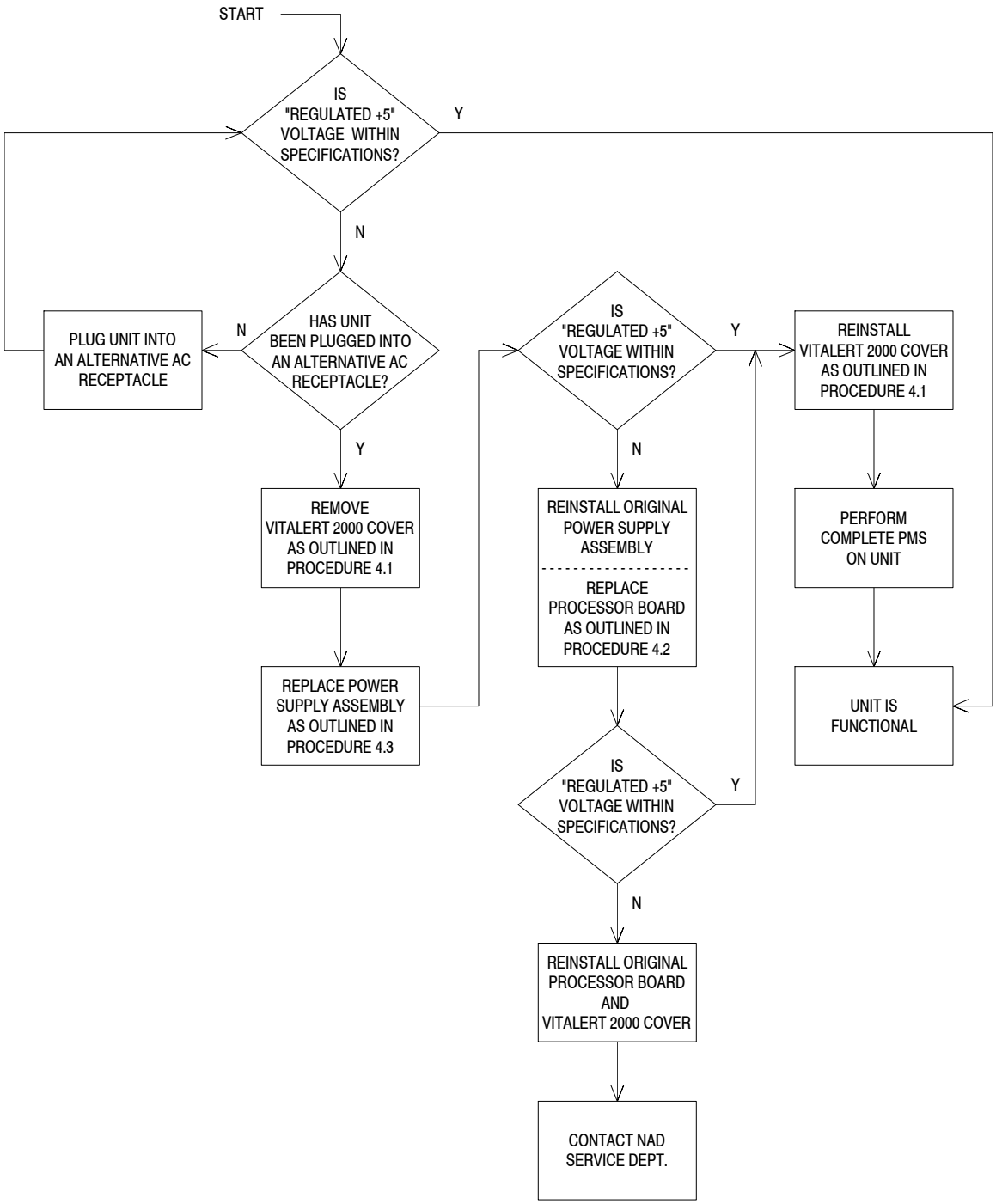
GUIDE 15: CB BATTERY voltage is not within specifications



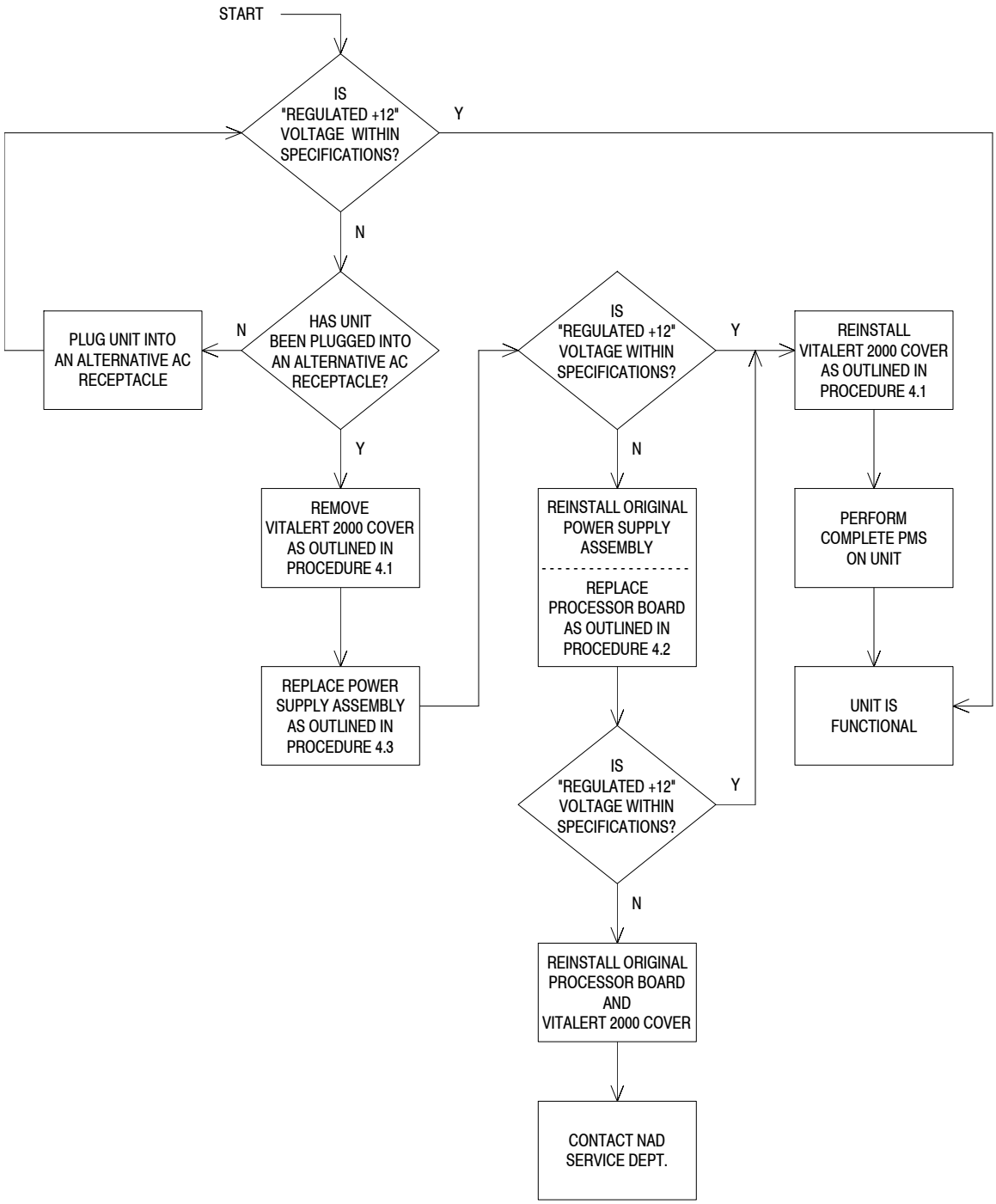
GUIDE 16: RAW DC is not within specifications



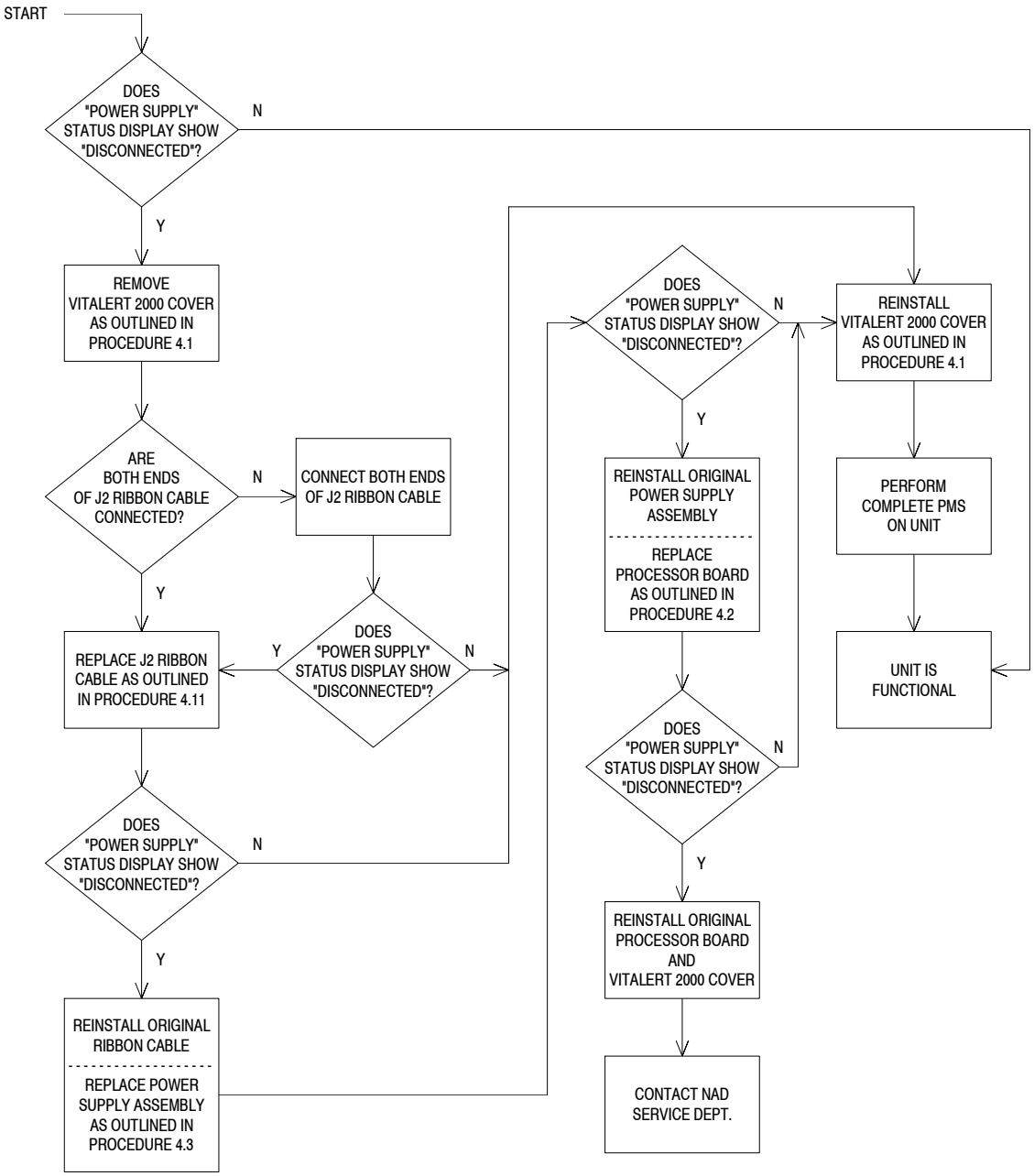
GUIDE 17: REGULATED +5 value is not within specifications



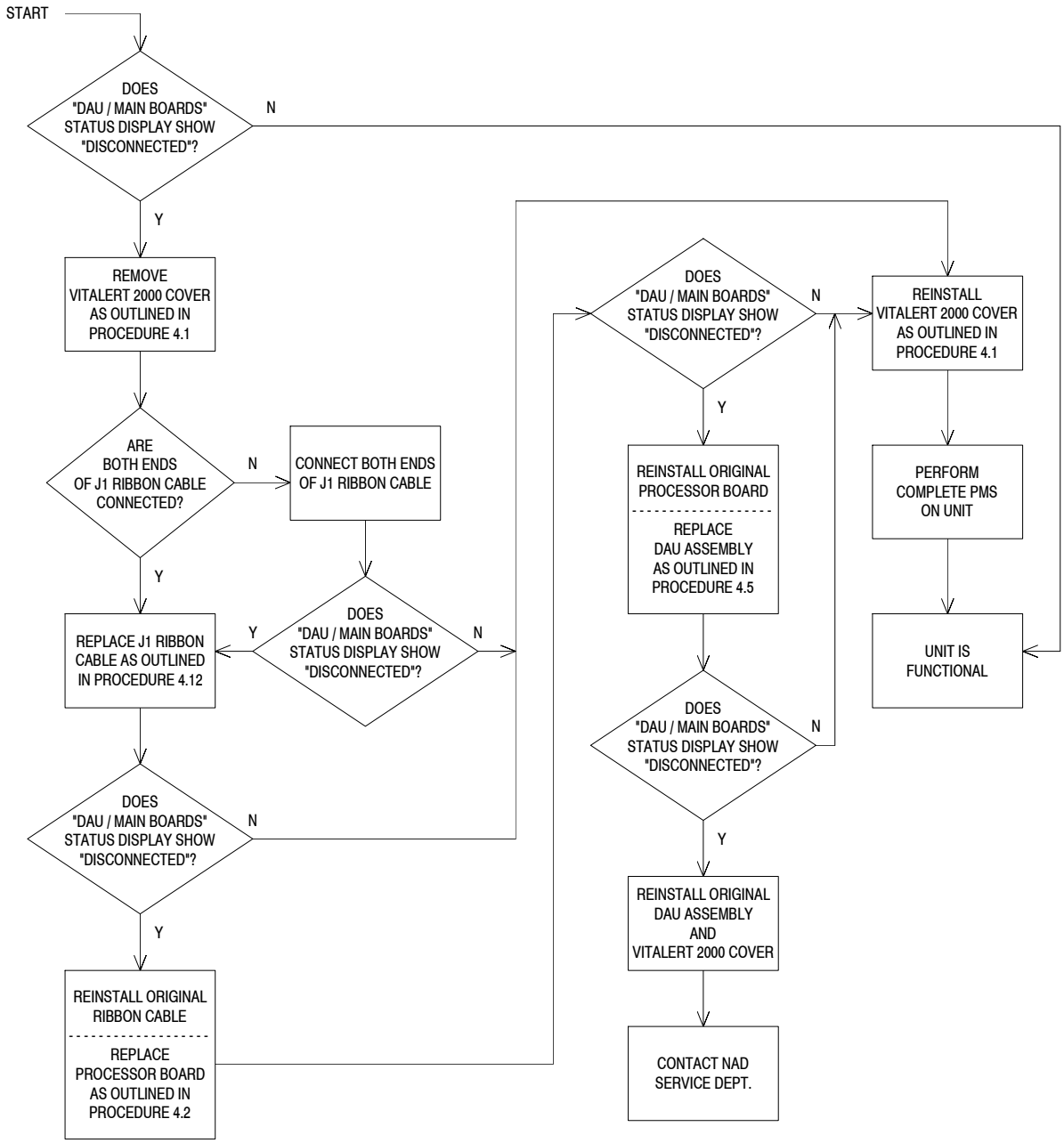
GUIDE 18: REGULATED +12 value is not within specifications



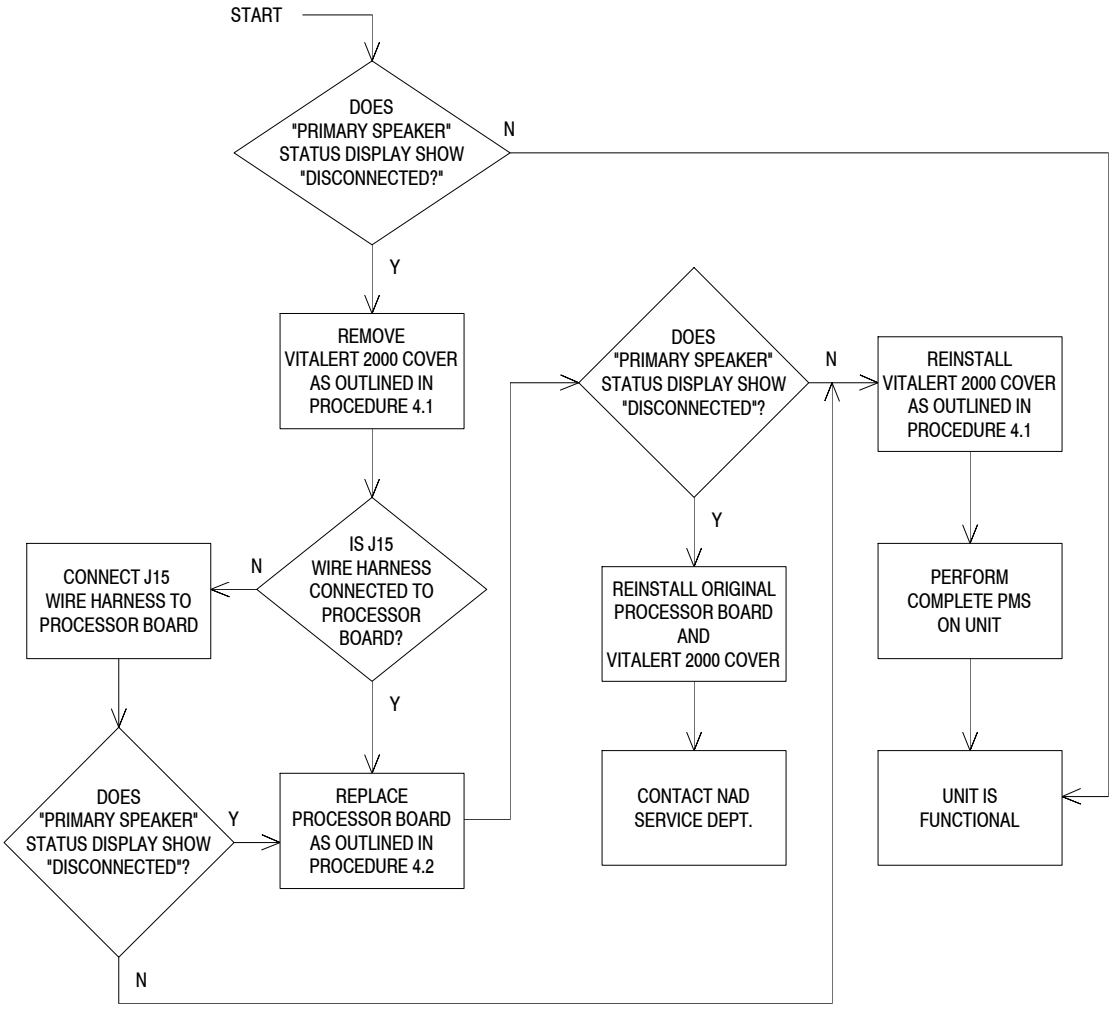
GUIDE 19: POWER SUPPLY status is DISCONNECTED



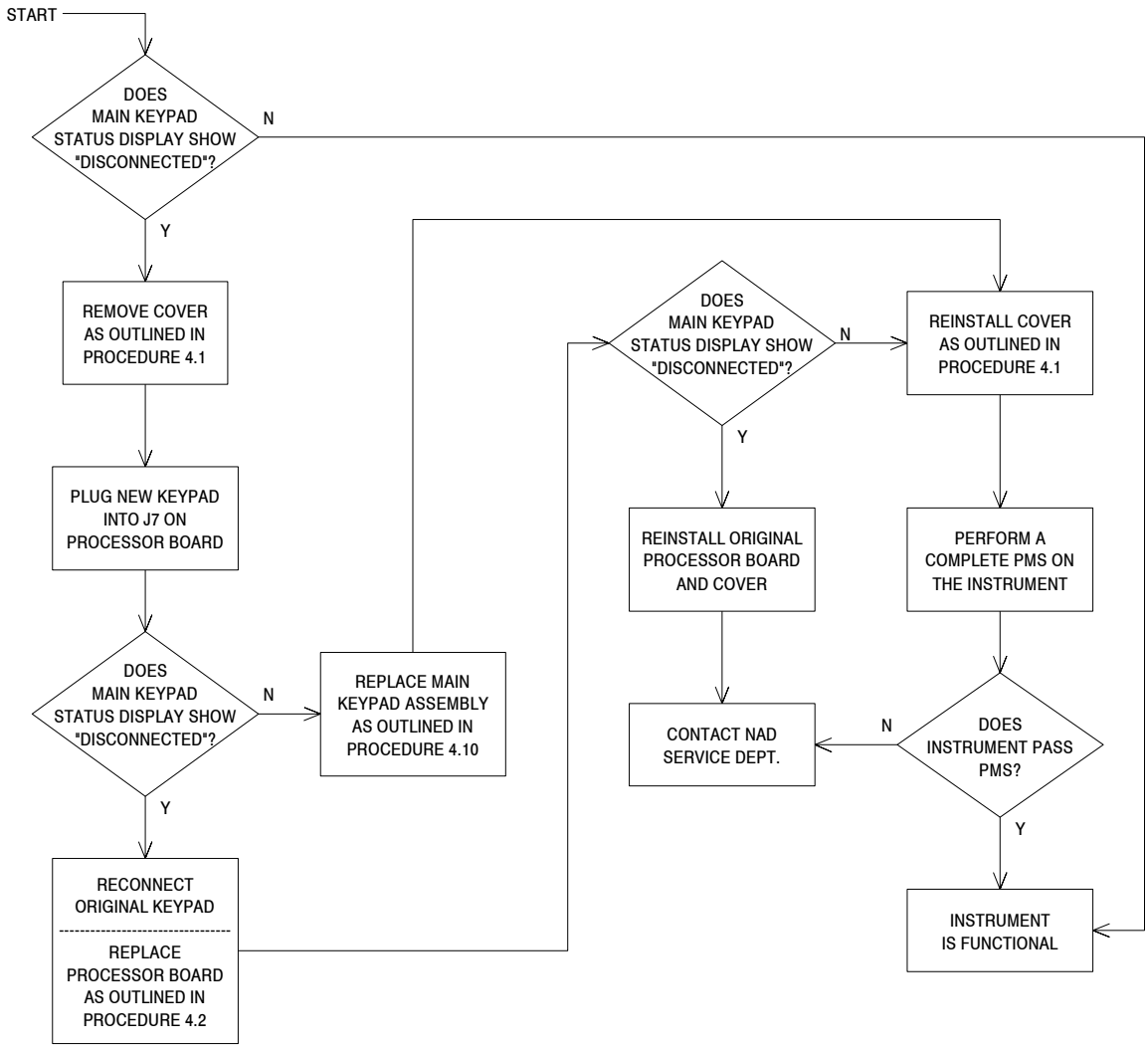
GUIDE 20: DAU/MAIN BOARD status is DISCONNECTED



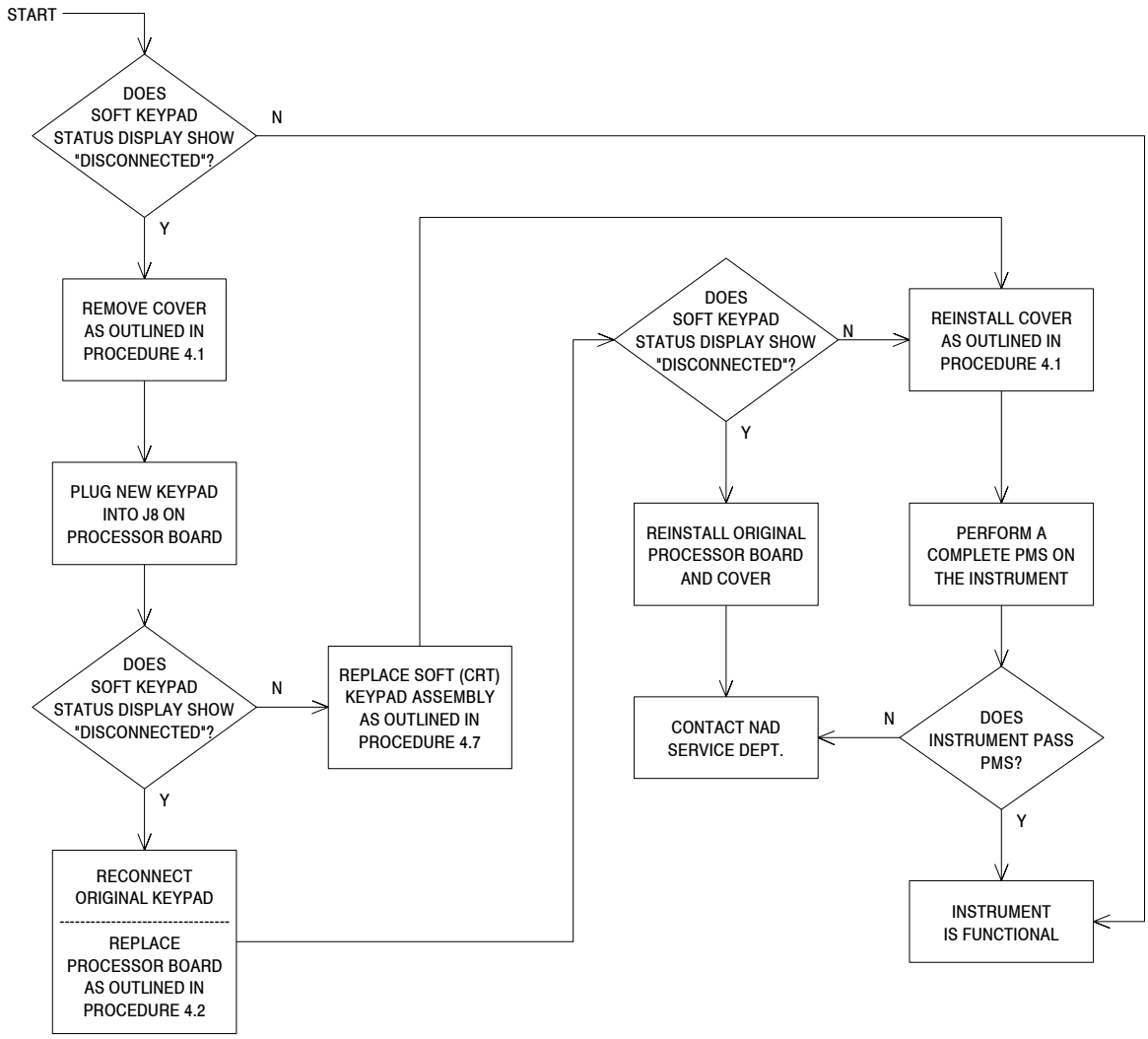
GUIDE 21: PRIMARY SPEAKER status is DISCONNECTED



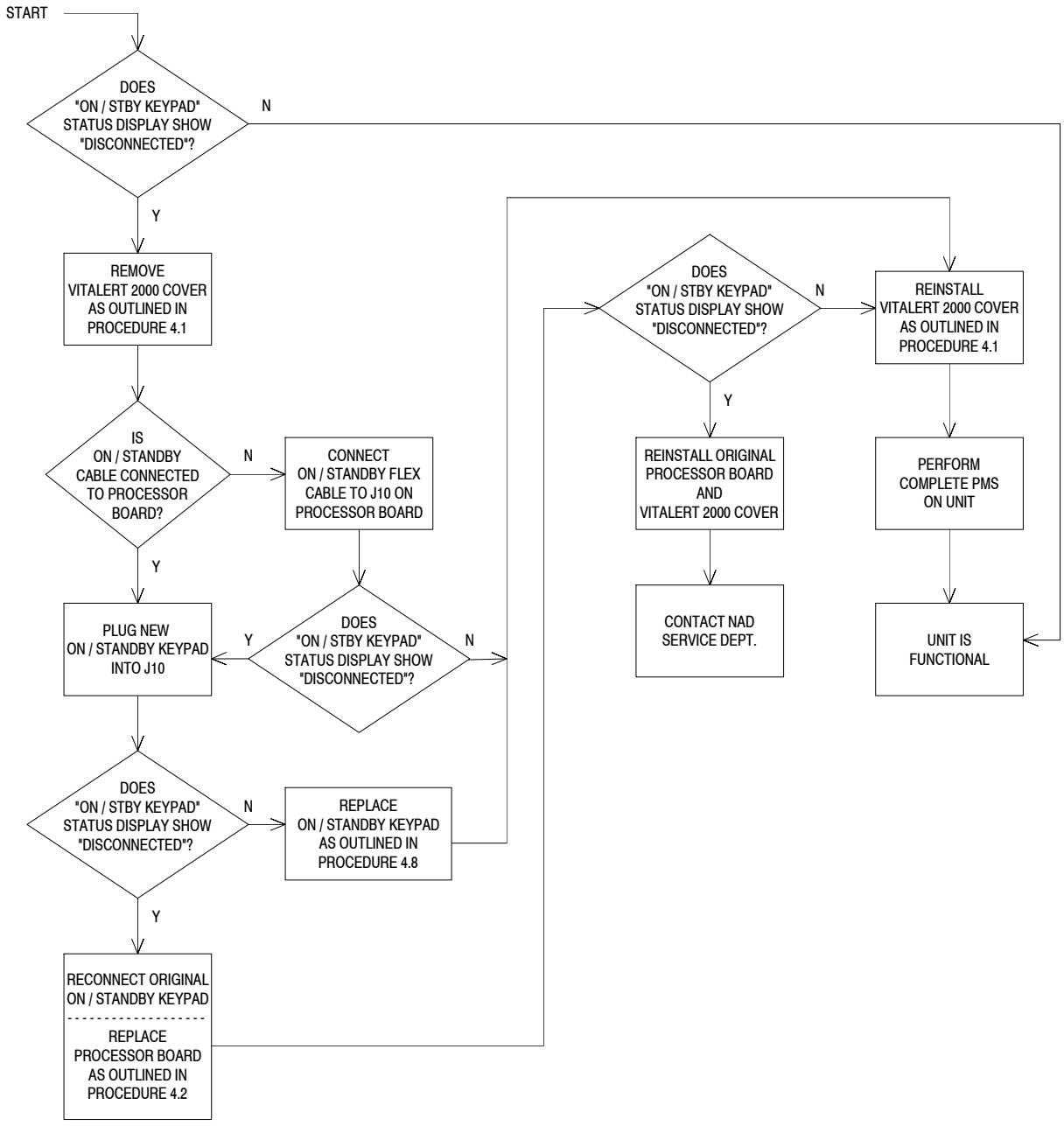
GUIDE 22: MAIN KEYPAD status is DISCONNECTED



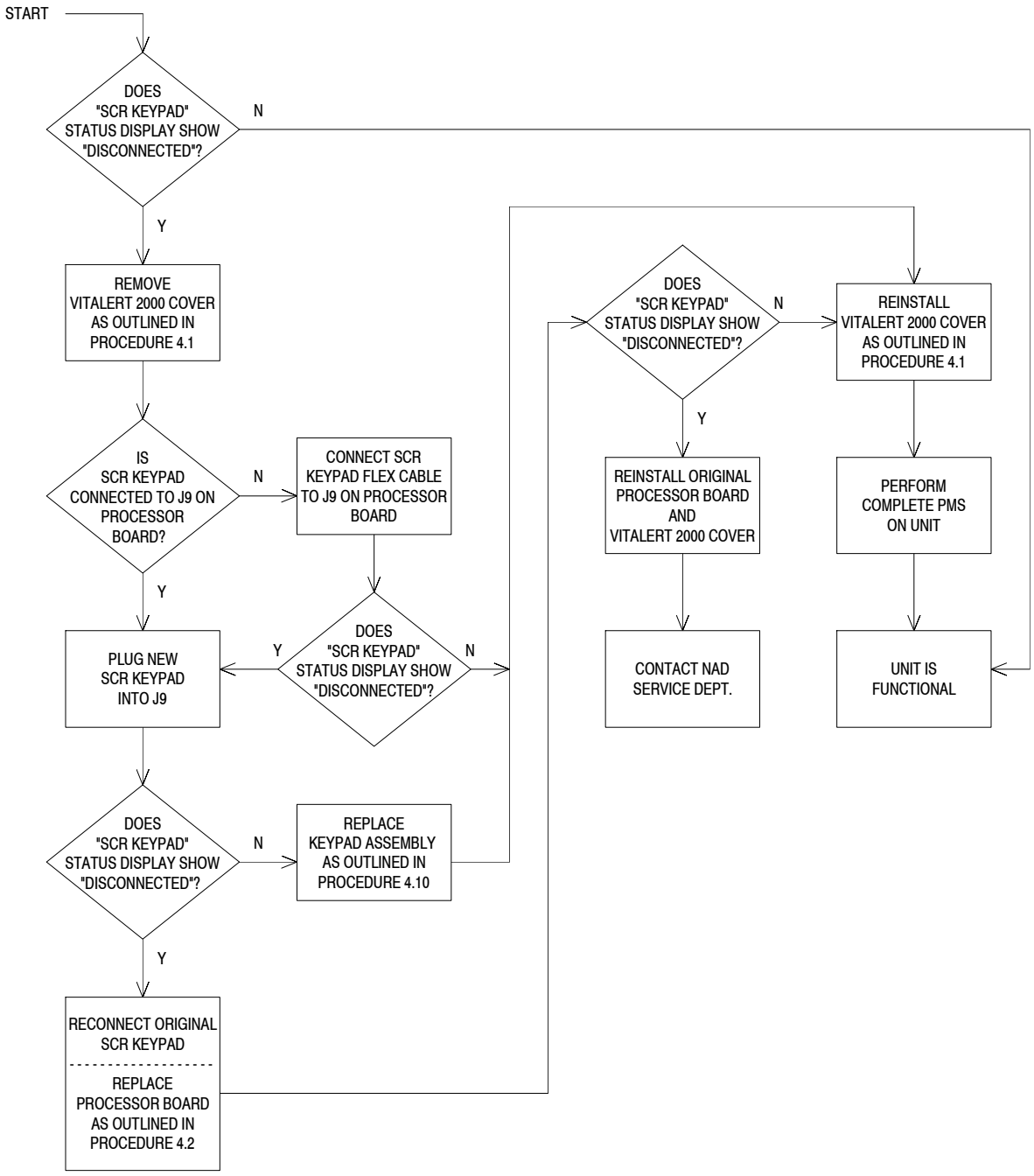
GUIDE 23: SOFT KEYPAD status is DISCONNECTED



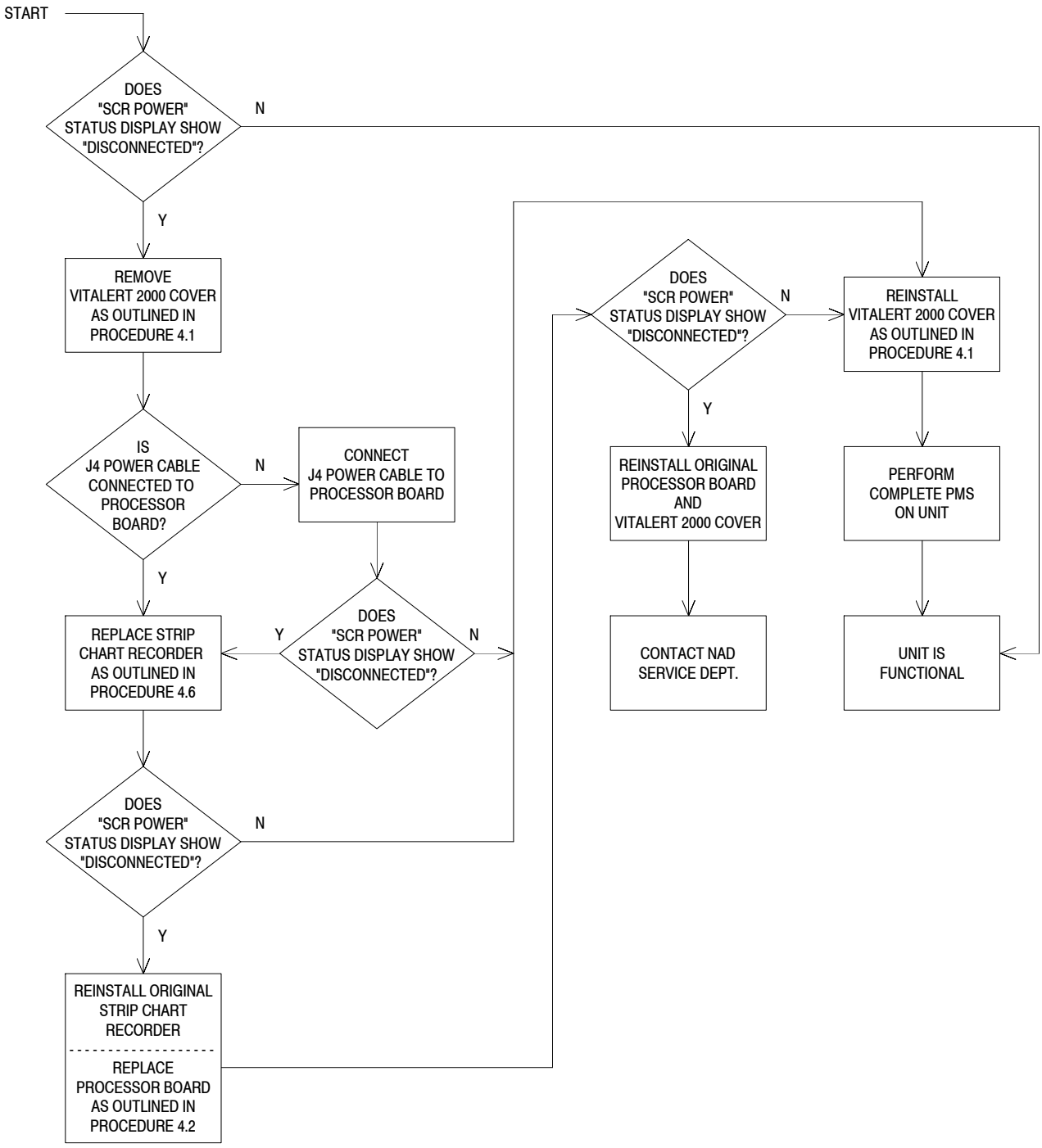
GUIDE 24: ON/STANDBY KEYPAD status is DISCONNECTED



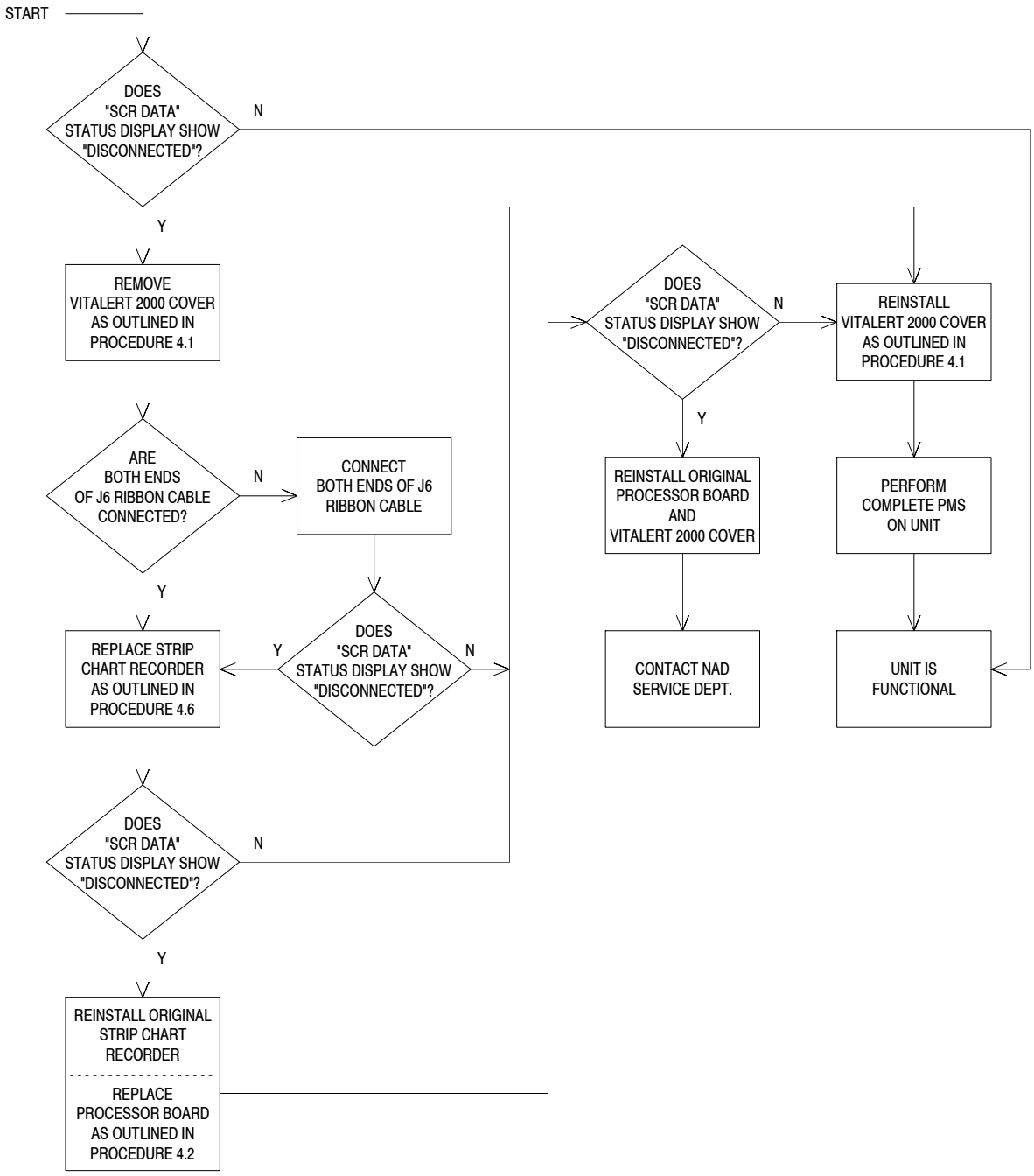
GUIDE 25: SCR KEYPAD status is DISCONNECTED



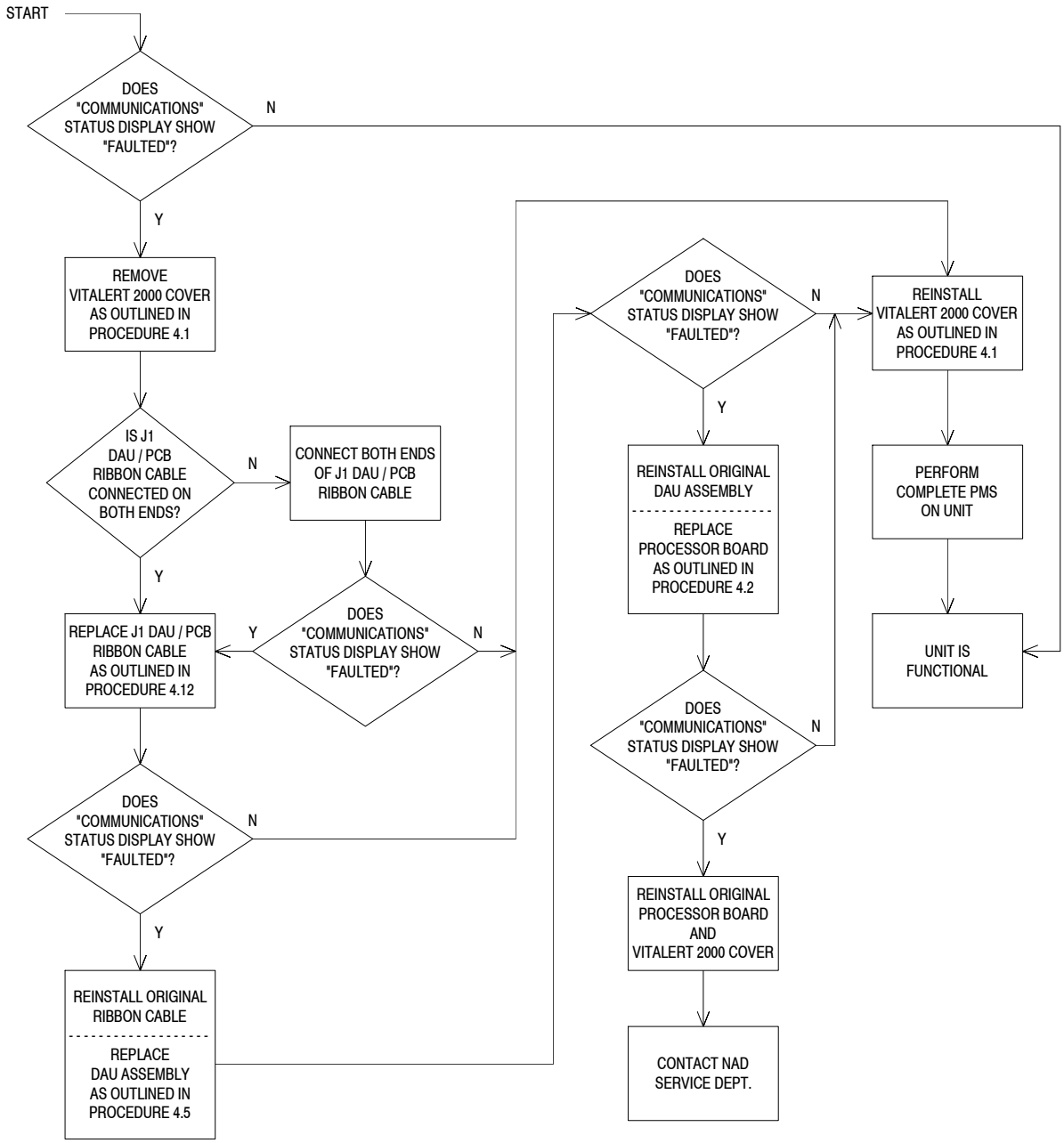
GUIDE 26: SCR POWER status is DISCONNECTED



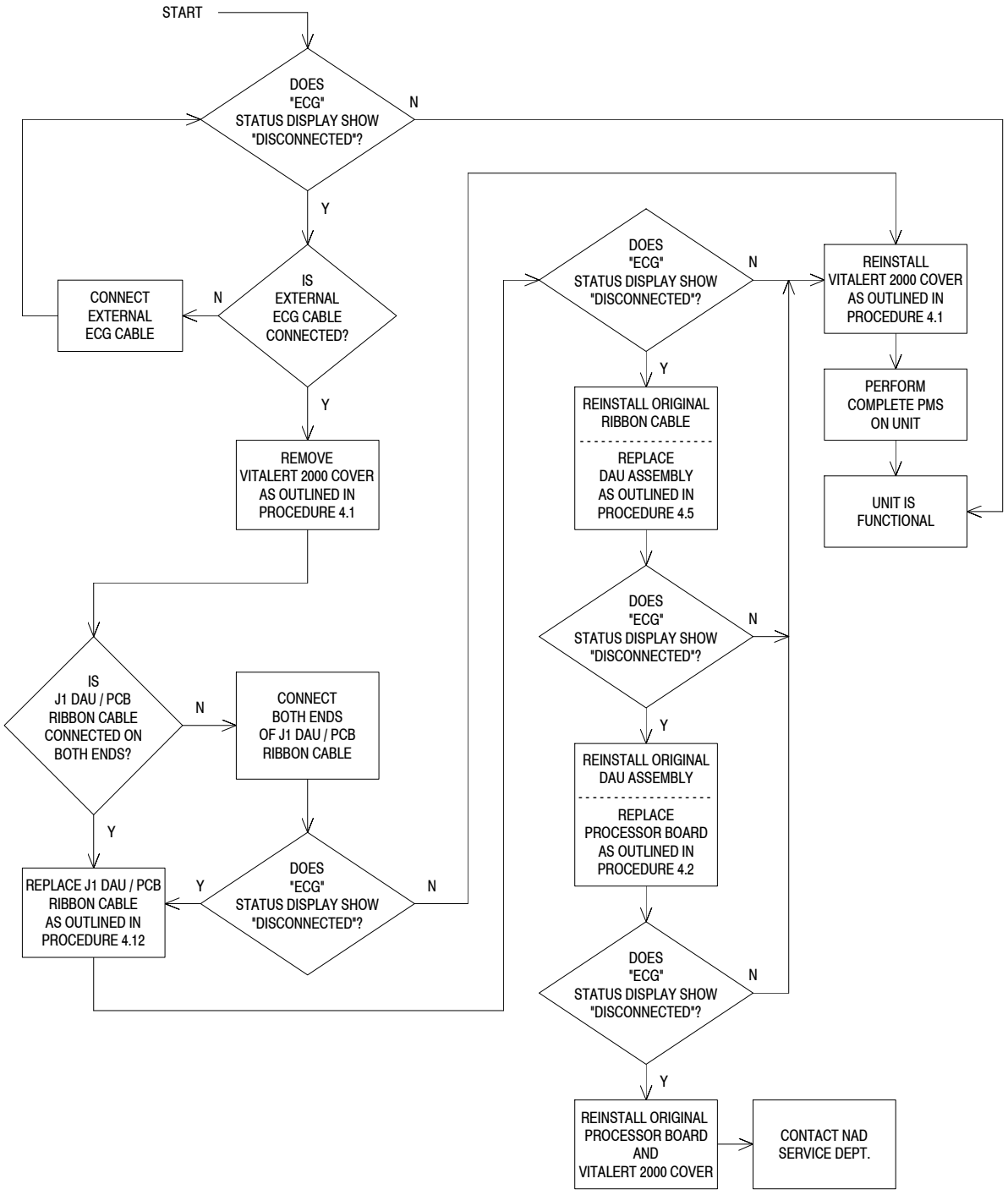
GUIDE 27: SCR DATA status is DISCONNECTED



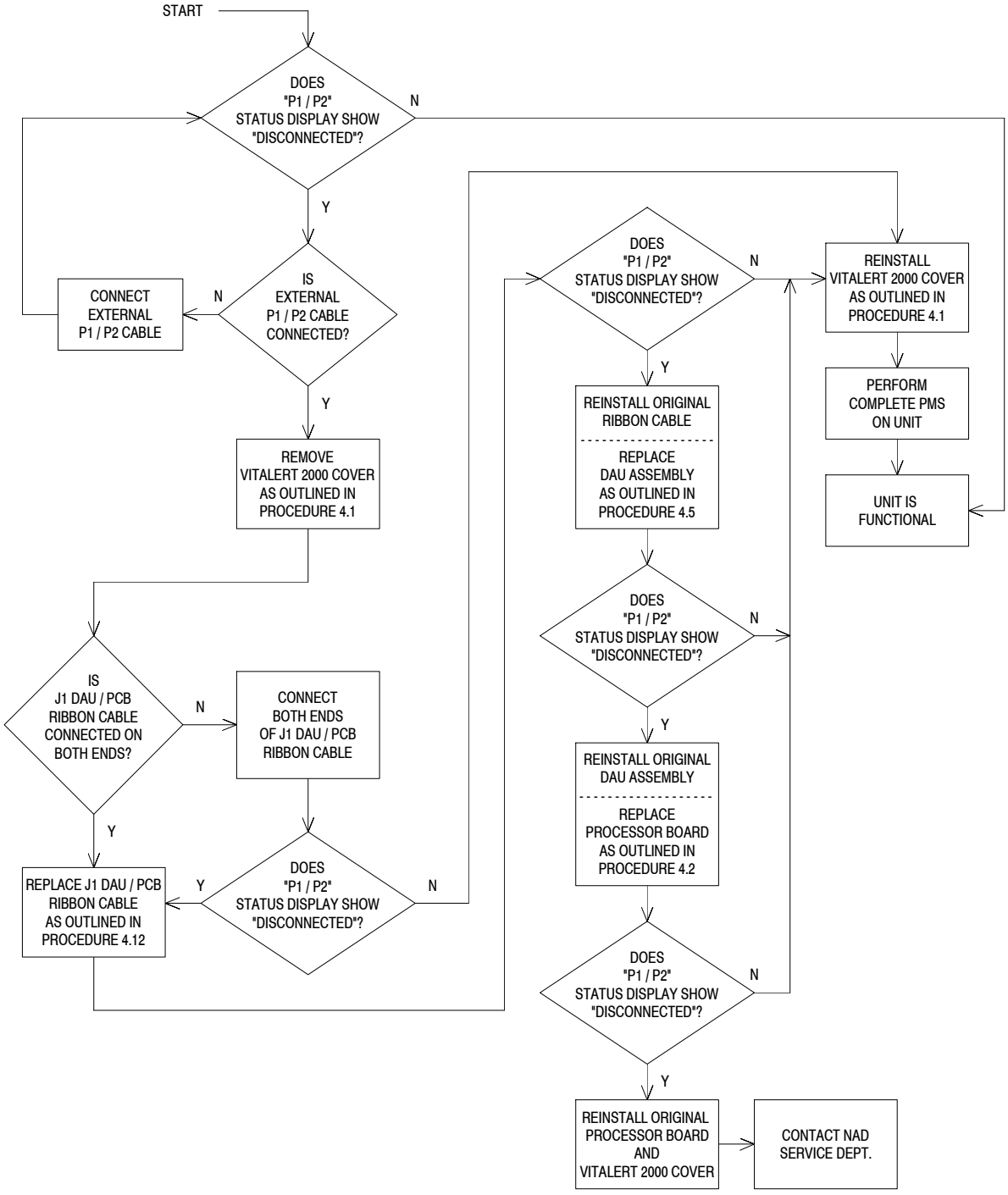
GUIDE 28: COMMUNICATIONS status is FAULTED



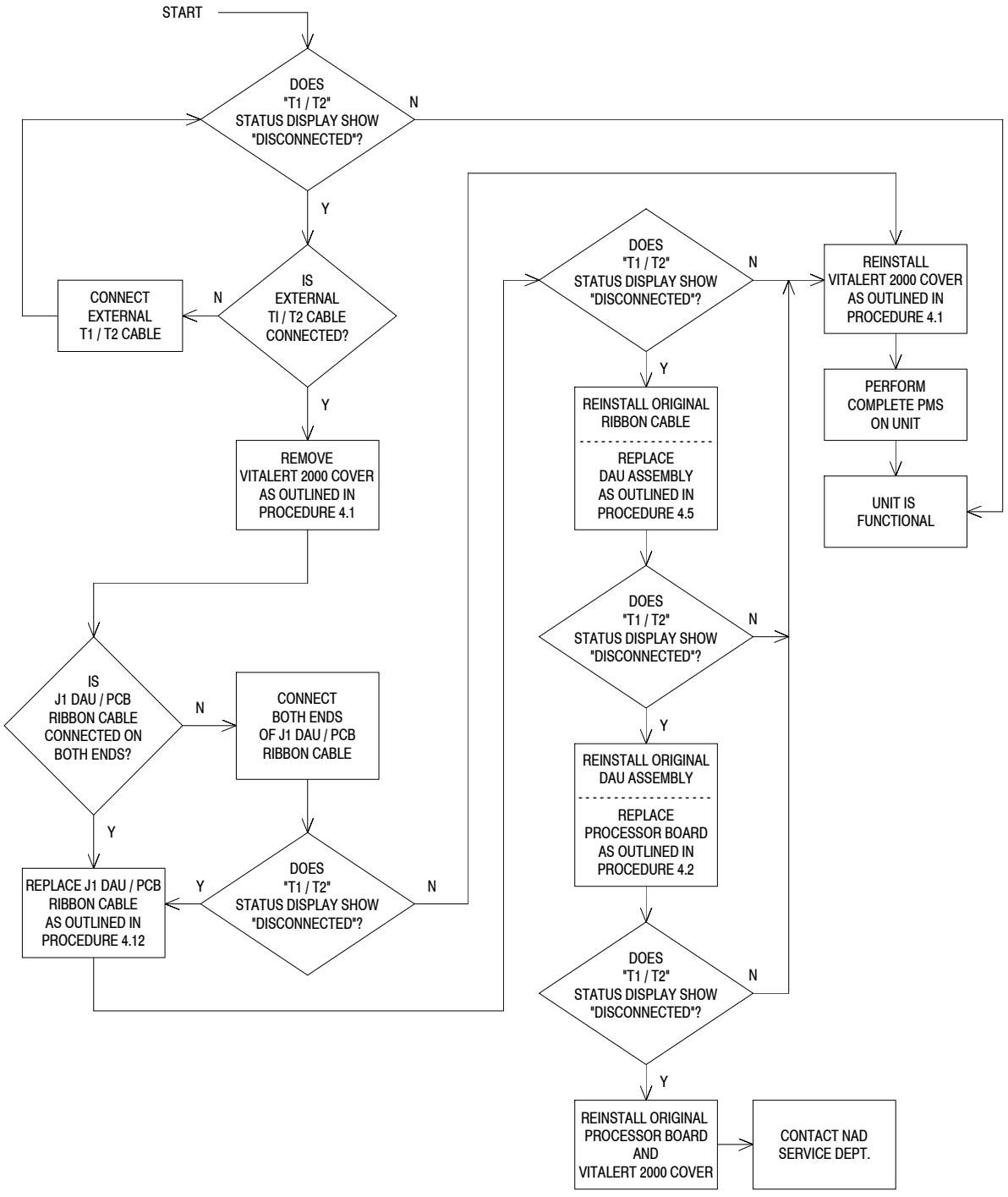
GUIDE 29: ECG status is DISCONNECTED



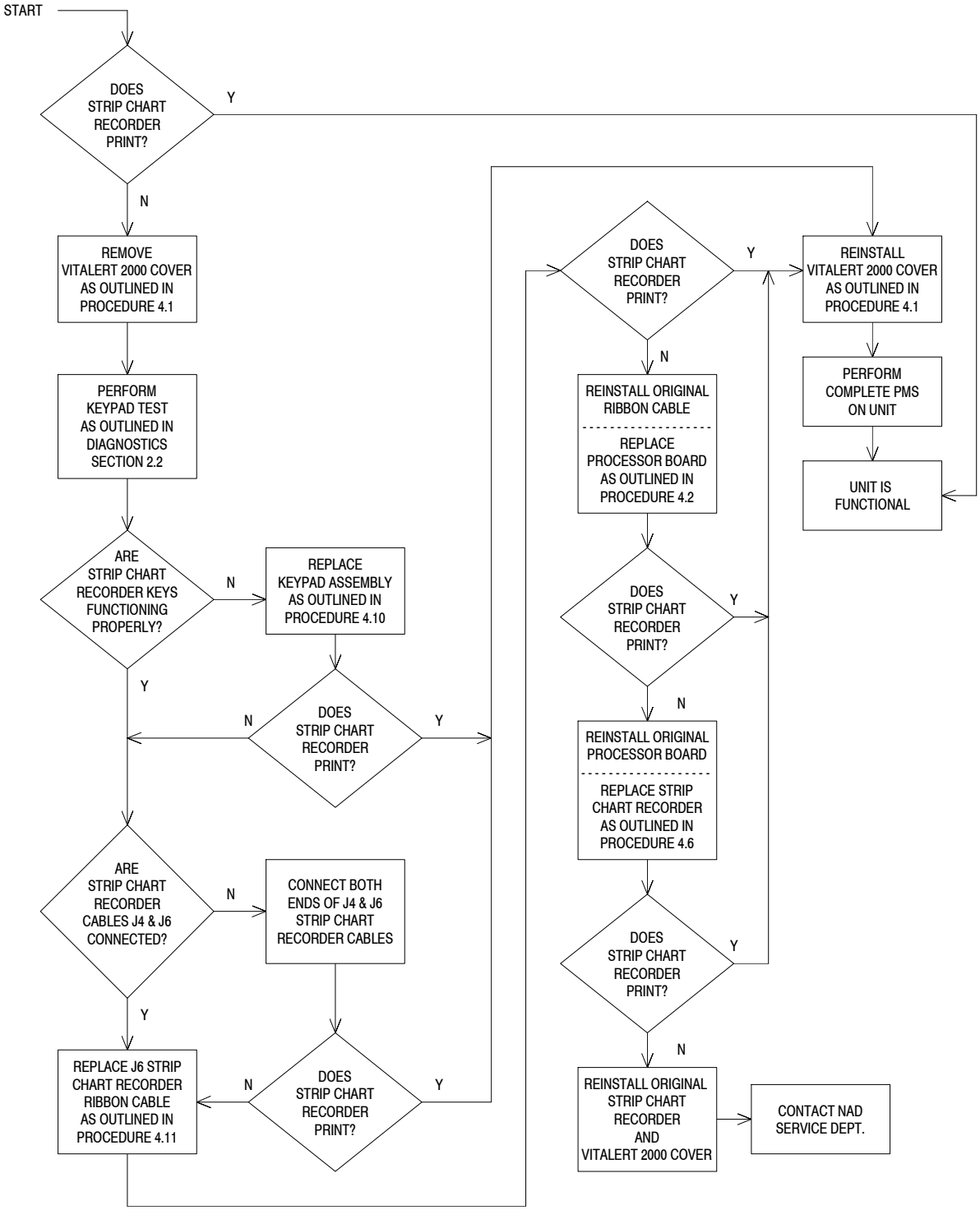
GUIDE 30: P1 or P2 status is DISCONNECTED



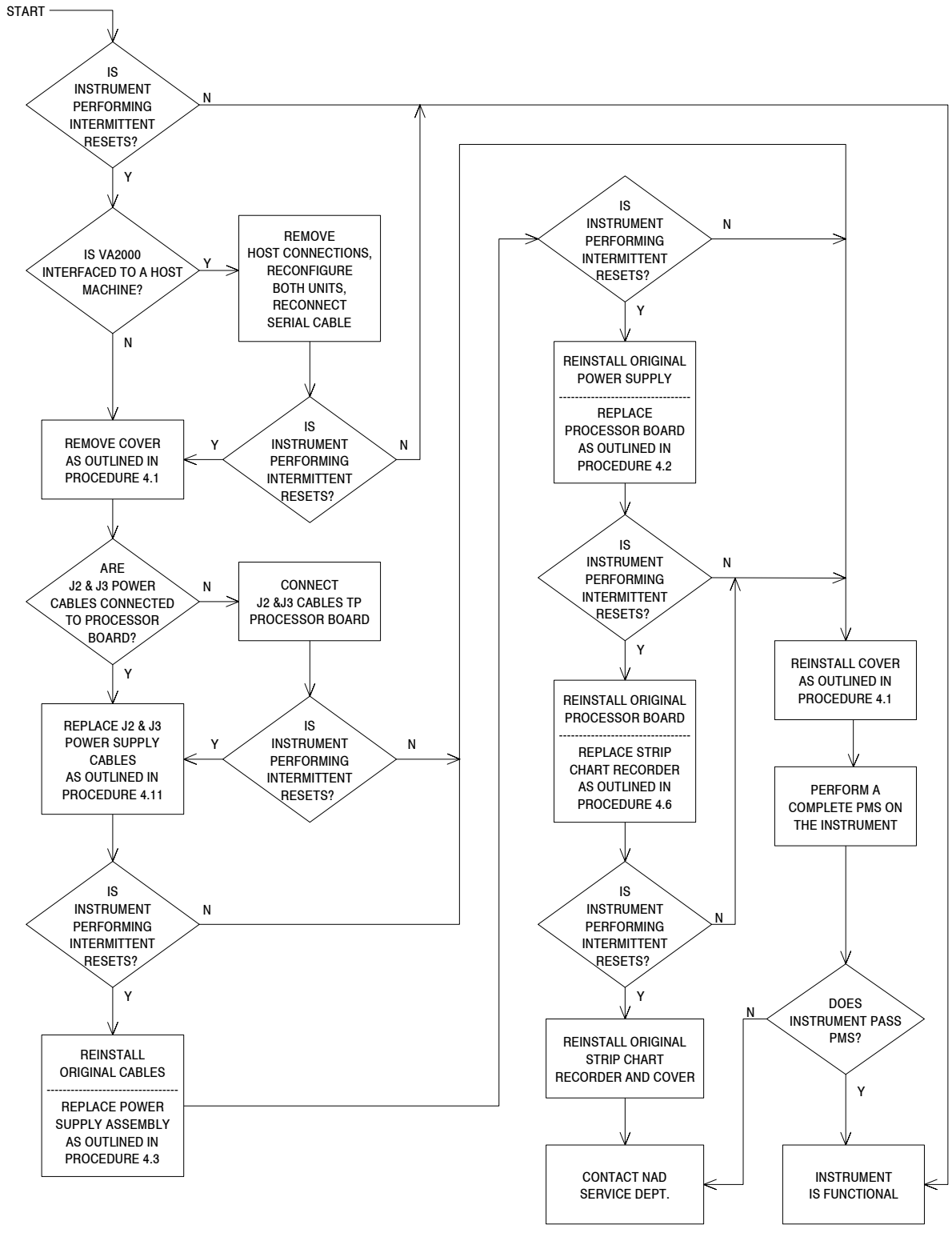
GUIDE 31: T1 or T2 status is DISCONNECTED



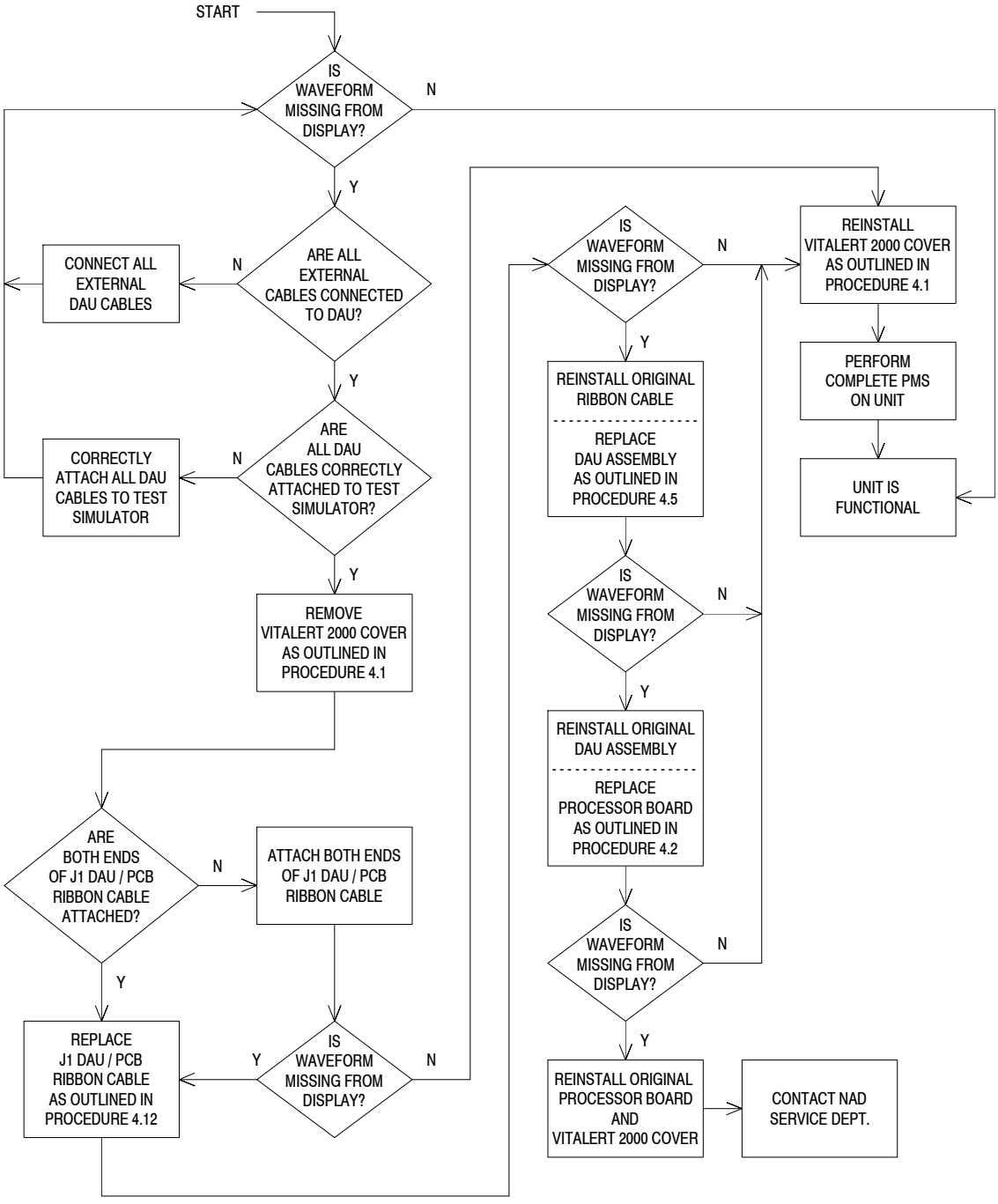
GUIDE 32: Strip Chart Recorder will not print



GUIDE 33: VITALERT 2000 is performing intermittent resets



GUIDE 34: Waveform is missing from the display screen



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4.0 REPLACEMENT PROCEDURES

This section outlines removal and replacement procedures for the field-replaceable assemblies of the VITALERT 2000 Monitoring System.

All procedures are to be performed only by a North American Dräger qualified Technical Service Representative (TSR).

The following replacement procedures are the only procedures authorized by North American Dräger to be performed in the field. All others shall be referred to NAD's Technical Service Department.

NOTE: **The PMS Procedure provided in Section 6 must be performed after any replacement, removal, calibration, or adjustment procedure.**

WARNING: **Hazardous voltages exist inside the VITALERT 2000 cabinet. Observe appropriate safety precautions when servicing the instrument. High voltage exists at the CRT even when AC power is disconnected.**

4.1 VITALERT 2000 Cover

The VITALERT 2000 cover is secured to the underside of the chassis by eight button head screws. The general arrangement of the cover is shown in Figure 4-1.

4.1.1 Press the STANDBY key on the front panel, and remove AC power from the instrument.

4.1.2 Disconnect the AC power cord by pressing in both retaining clips and pulling the cord out.

4.1.3 Disable CB1 and CB2 on the rear panel by pulling out each button with a knife or sharp object.

4.1.4 Disconnect the data cable from the instrument.

4.1.5 Disconnect all cables from the patient interface panel on the left side of the instrument.

4.1.6 On a clean working surface, turn the instrument onto its side.

4.1.7 Remove the button head screws securing the cover to the bottom of the chassis.

4.1.8 Carefully rotate the instrument back to an upright position.

4.1.9 Remove the cover by sliding it towards the rear of the chassis.

.....

4.1.10 Following adjustment or repair, position the cover at the rear of the chassis and slide it towards the front.

4.1.11 Turn the instrument onto its side and replace the button head screws to secure the cover to the chassis.

4.1.12 Rotate the instrument back to an upright position.

4.1.13 Connect the data cable and all patient interface panel cables.

4.1.14 Enable CB1 and CB2 on the rear panel.

4.1.15 Connect the AC power cord to the instrument.

4.1.16 Perform the PMS Procedure given in Section 6.

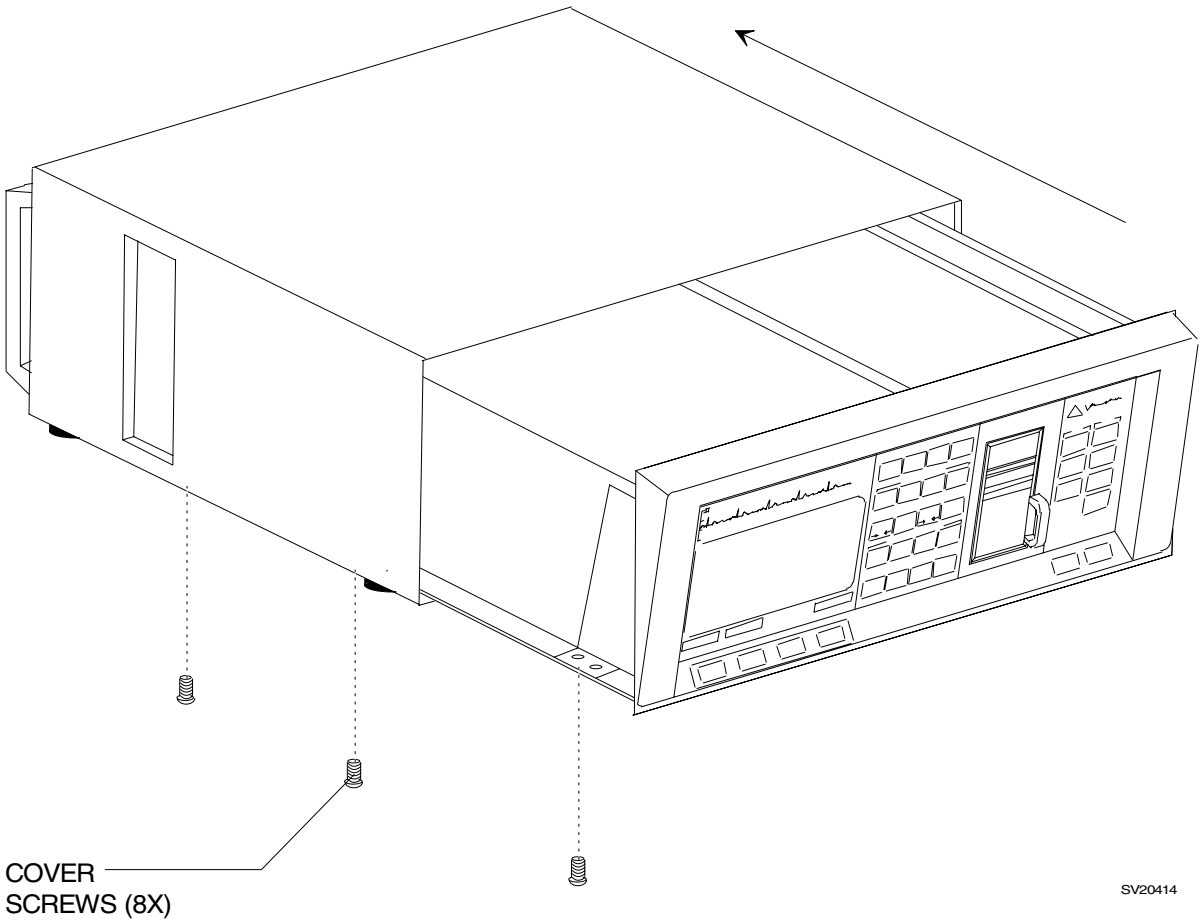


Figure 4-1: VITALERT 2000 COVER REMOVAL

4.2 Processor Board Assembly

The VITALERT 2000 cover must be removed to gain access to the Processor Board Assembly. Figure 4-2 shows the location of the processor board and its mounting arrangement.

4.2.1 Remove the VITALERT 2000 cover as outlined in Procedure 4.1.

CAUTION: The processor board contains static-sensitive devices. Use ESD protection when handling this board.

4.2.2 Disconnect the DAU ribbon cable from J1 on the processor board.

4.2.3 Disconnect the power supply ribbon cable from J2 on the processor board.

4.2.4 Disconnect the power supply wire harness from J3 on the processor board.

4.2.5 Disconnect the strip chart recorder power cable from J4 on the processor board.

4.2.6 Disconnect the CRT assembly ribbon cable from J5 on the processor board.

4.2.7 Disconnect the strip chart recorder ribbon cable from J6 on the processor board.

4.2.8 Disconnect the main keypad cable from J7 on the processor board.

4.2.9 Disconnect the CRT keypad cable from J8 on the processor board.

4.2.10 Disconnect the strip chart recorder keypad cable from J9 on the processor board.

4.2.11 Disconnect the On/Standby keypad cable from J10 on the processor board.

4.2.12 Loosen the captive screws securing the processor board assembly, and remove the assembly.

4.2.13 Position the replacement processor board assembly in the chassis and fasten the captive mounting screws.

4.2.14 Connect the cables to J1 through J10.

4.2.15 Reinstall the VITALERT 2000 cover.

4.2.16 Restore power to the instrument and run the diagnostics provided in Section 2 to verify that the replacement processor board is working properly.

4.2.17 Enter the Configuration screen and reset the time and date; then press the STANDBY key, followed by the ON key. This procedure ensures the correct time on trend plots.

4.2.18 Perform the PMS Procedure given in Section 6.

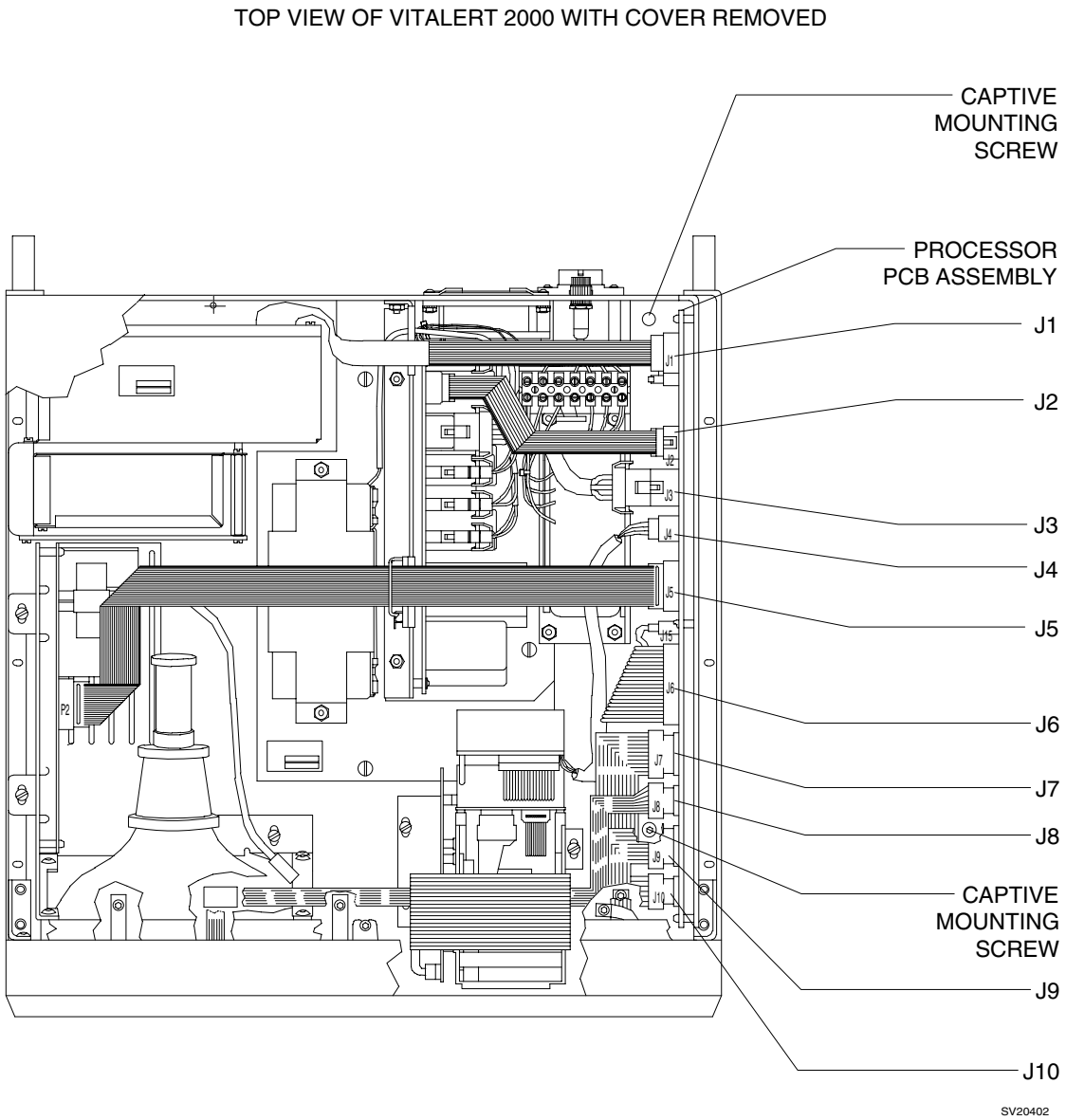


Figure 4-2: REPLACEMENT OF PROCESSOR BOARD ASSEMBLY

4.3 Power Supply Assembly

The VITALERT 2000 cover must be removed to gain access to the Power Supply Assembly. Figure 4-3 shows the location of the power supply and its mounting arrangement. The battery on the power supply assembly is replaceable without removing the power supply from the chassis. Refer to the appropriate sub-section for battery replacement instructions.

4.3.1 Remove the VITALERT 2000 cover as outlined in Procedure 4.1.

4.3.2 Disconnect the DAU - processor cable from J1 on the processor board.

4.3.3 Disconnect the power supply ribbon cable from J5 on the power supply PCB assembly, and from J2 on the processor board.

4.3.4 Disconnect the power supply wire harness from J4 on the power supply PCB assembly, and from J3 on the processor board.

4.3.5 Disconnect the CRT cable from J5 on the processor board, and open its cable retainer clamp on the power supply assembly.

4.3.6 Loosen the captive screws securing the power supply assembly, and remove the assembly.

4.3.7 Position the replacement power supply assembly in the chassis, and fasten the captive mounting screws.

4.3.8 Reinstall the wire harness from J4 on the power supply PCB assembly to J3 on the processor board.

4.3.9 Reinstall the ribbon cable from J5 on the power supply PCB assembly to J2 on the processor board.

4.3.10 Connect the DAU - processor cable to J1 on the processor board.

4.3.11 Connect the CRT cable to J5 on the processor board, and secure the cable in the retainer clamp on the power supply assembly.

4.3.12 Reinstall the VITALERT 2000 cover.

4.3.13 Restore power to the instrument and, after sufficient battery charging time, run the power supply diagnostic provided in Section 2 to verify that the voltages are within allowable tolerances.

4.3.14 Perform the PMS Procedure given in Section 6.

TOP VIEW OF VITALERT 2000 WITH COVER REMOVED

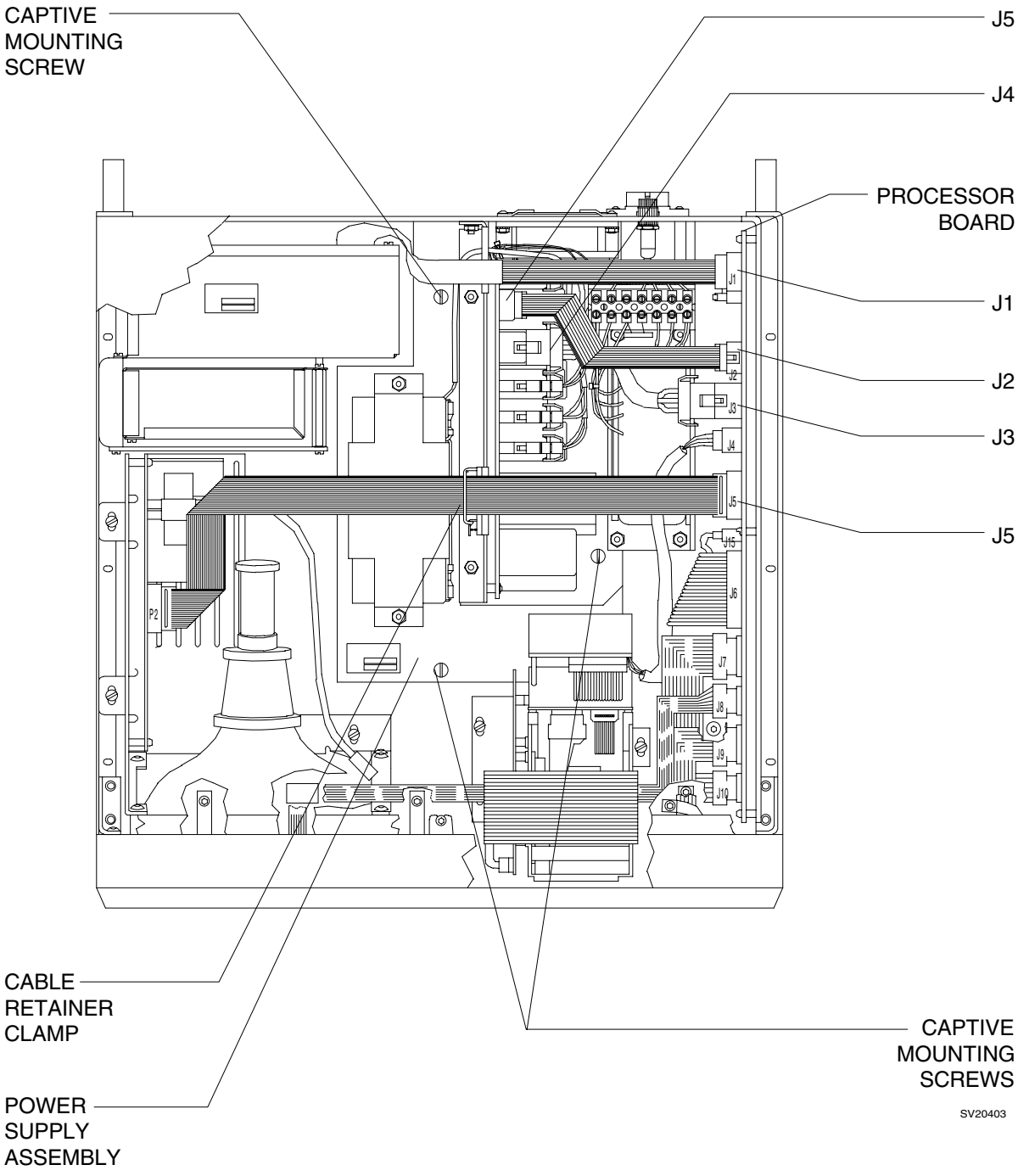


Figure 4-3: REPLACEMENT OF POWER SUPPLY ASSEMBLY

4.4 CRT Assembly

The VITALERT 2000 cover must be removed to gain access to the CRT assembly. Figure 4-4 shows the location of the CRT assembly and its mounting arrangement.

4.4.1 Remove the VITALERT 2000 cover as outlined in Procedure 4.1.

4.4.2 Disconnect the CRT cable from P2 on the CRT assembly.

4.4.3 Remove the three screws securing the CRT assembly.

4.4.4 Carefully rotate the CRT assembly until it clears the DAU, and lift out the CRT assembly from the chassis.

4.4.5 Carefully position the replacement CRT assembly in the chassis, and replace the screws that were previously removed.

4.4.6 Connect the CRT cable to P2 on the CRT assembly.

4.4.7 Reinstall the VITALERT 2000 cover.

4.4.8 Restore power to the instrument and observe the CRT Geometry Screen in the Service Diagnostics Menu (see Section 2) to verify that the replacement CRT assembly is working properly. Should any adjustments be needed, refer to Section 5.1.

4.4.9 Perform the PMS Procedure given in Section 6.

TOP VIEW OF VITALERT 2000 WITH COVER REMOVED

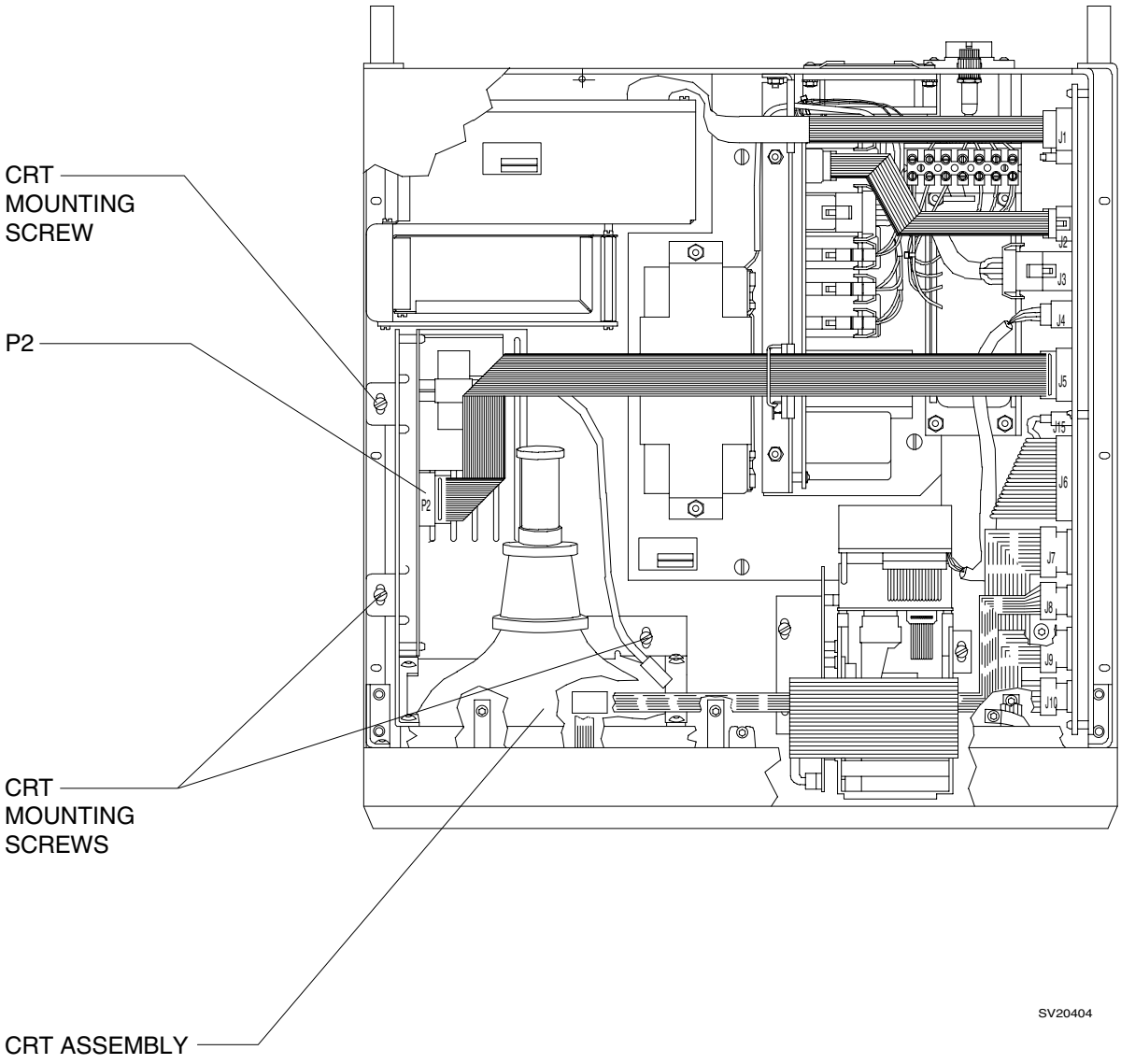


Figure 4-4: REPLACEMENT OF CRT ASSEMBLY

4.5 DAU Assembly

The VITALERT 2000 cover must be removed to gain access to the DAU assembly. Figure 4-5 shows the location of the DAU assembly in the chassis, along with the arrangement of its mounting nuts on the bottom of the chassis.

4.5.1 Remove the VITALERT 2000 cover as outlined in Procedure 4.1.

4.5.2 Disconnect the DAU ribbon cable from J1 on the processor board.

4.5.3 Carefully turn the VITALERT 2000 onto its side.

4.5.4 Remove the nuts securing the DAU assembly to the chassis (hold the assembly while removing the nuts so it does not fall out of the chassis), and remove the DAU assembly.

4.5.5 Position the replacement DAU assembly in the chassis, and replace the nuts that were previously removed.

4.5.6 Turn the VITALERT 2000 back to its normal position.

4.5.7 Connect the ribbon cable to J1 on the processor board.

4.5.8 Reinstall the VITALERT 2000 cover.

4.5.9 Restore power to the instrument and run the DAU diagnostics provided in Section 2 to verify that the replacement DAU assembly is working properly. Should any calibration be needed, Refer to Section 5.2.

4.5.10 Perform the PMS Procedure given in Section 6.

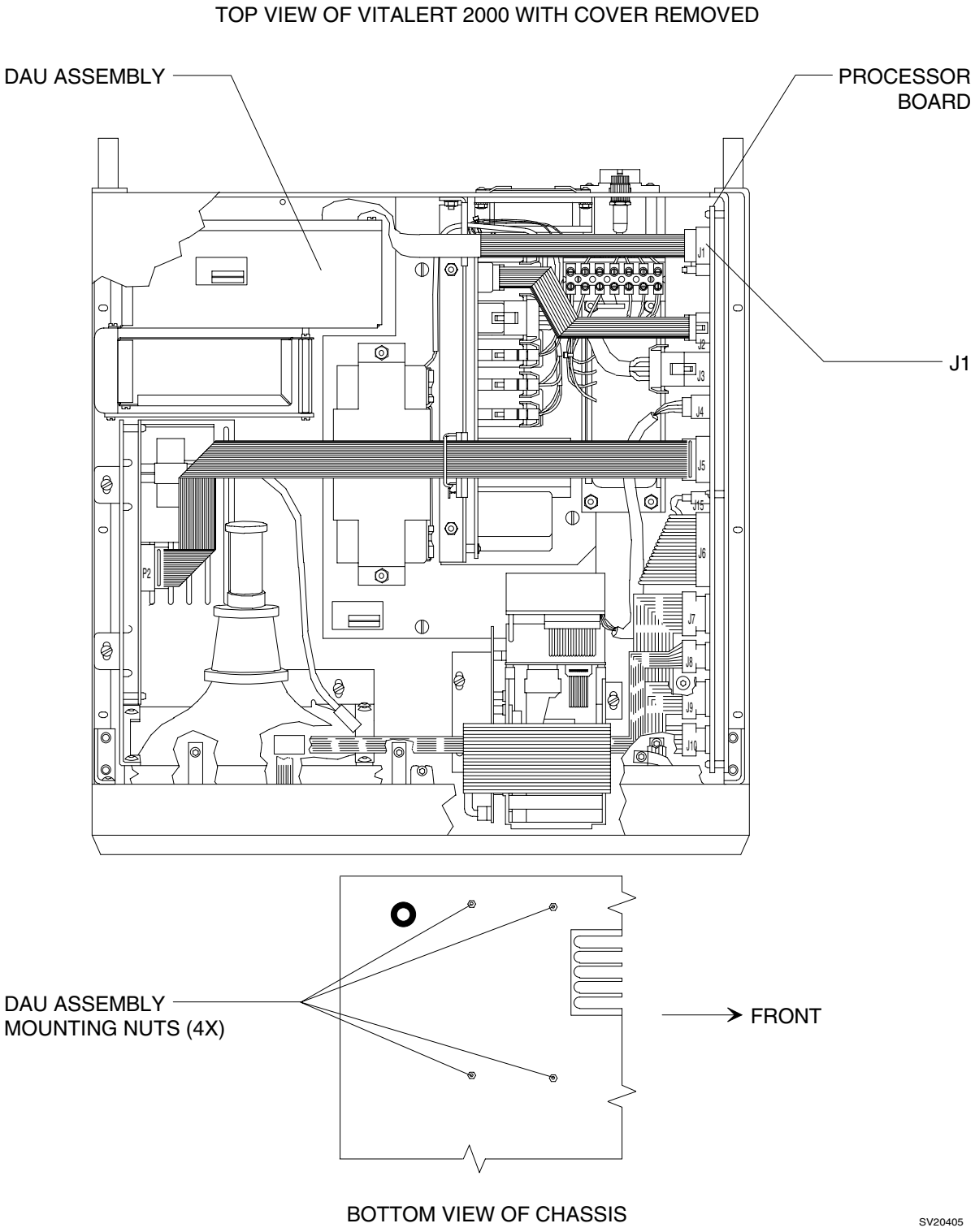


Figure 4-5: REPLACEMENT OF DAU ASSEMBLY

4.6 Strip Chart Recorder

Replacement of the Strip Chart Recorder requires removal of the VITALERT 2000 cover to gain access to the recorder connections. Figure 4-6 shows the location of the recorder and its mounting arrangement.

4.6.1 Remove the cover as outlined in Procedure 4.1.

4.6.2 Disconnect data cable from P1 on the strip chart recorder.

4.6.3 Disconnect the recorder power cable from J4 on the processor board.

4.6.4 Remove the three screws securing the strip chart recorder to the chassis.

4.6.5 Carefully slide the strip chart recorder back and lift it from the chassis.

4.6.6 Position the replacement recorder in the chassis and fasten its mounting screws.

4.6.7 Connect the data cable to P1 on the recorder.

4.6.8 Connect the recorder power cable to J4 on the processor board.

4.6.9 Reinstall the VITALERT 2000 cover.

4.6.10 Restore power to the instrument and exercise the print functions to verify that the recorder is working properly.

4.6.11 Perform the PMS Procedure given in Section 6.

TOP VIEW OF VITALERT 2000 WITH COVER REMOVED

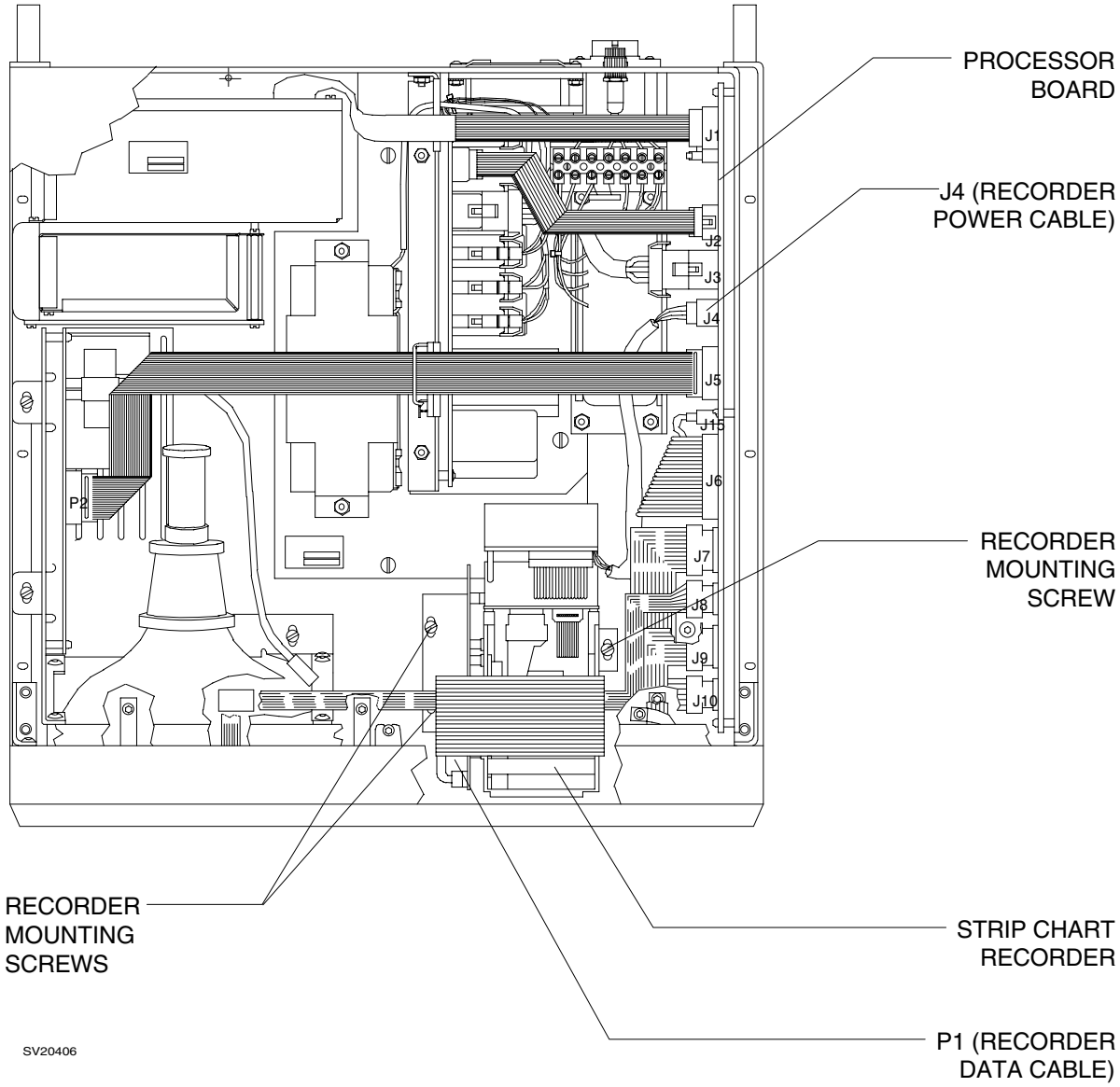


Figure 4-6: REPLACEMENT OF STRIP CHART RECORDER

4.7 CRT Keypad

Replacement of the CRT Keypad requires removal of the VITALERT 2000 cover, and removal of the CRT assembly. Figure 4-7 shows the location of the keypad ground strap and the keypad flex cable connection to the processor board.

4.7.1 Remove the cover as outlined in Procedure 4.1.

4.7.2 Disconnect the CRT cable from P2 on the CRT assembly.

4.7.3 Remove the three screws securing the CRT assembly to the chassis.

4.7.4 Carefully rotate the CRT assembly until it clears the DAU, and lift the CRT assembly from the chassis.

4.7.5 Disconnect the CRT keypad from J8 on the processor board.

4.7.6 Remove the button head screw securing the CRT keypad ground strap.

4.7.7 Carefully peel the keypad from the bezel assembly and guide the flex cable through the bezel.

4.7.8 Thoroughly clean the surface where the new keypad will be installed.

4.7.9 Working from the outside with one hand, guide the new CRT keypad flex cable through the appropriate hole in the bezel assembly. With the other hand, direct the flex cable under the strip chart recorder. Do not pull the cable tight.

4.7.10 Peel off the protective paper backing on the new CRT keypad.

4.7.11 Guide the ground strap through its corresponding hole in the bezel assembly, and press the new CRT keypad firmly into place.

4.7.12 Secure the keypad ground strap with the screw that was previously removed, and connect the flex cable to J8 on the processor board.

4.7.13 Reinstall the CRT assembly and connect the CRT cable to P2 on the CRT assembly.

4.7.14 Reinstall the VITALERT 2000 cover.

4.7.15 Restore power to the instrument and verify that the new keypad is functioning properly by using the Keyboard Test in the Service Diagnostics Menu. See Section 2.

4.7.16 Perform the PMS Procedure given in Section 6.

TOP VIEW OF VITALERT 2000 WITH COVER REMOVED

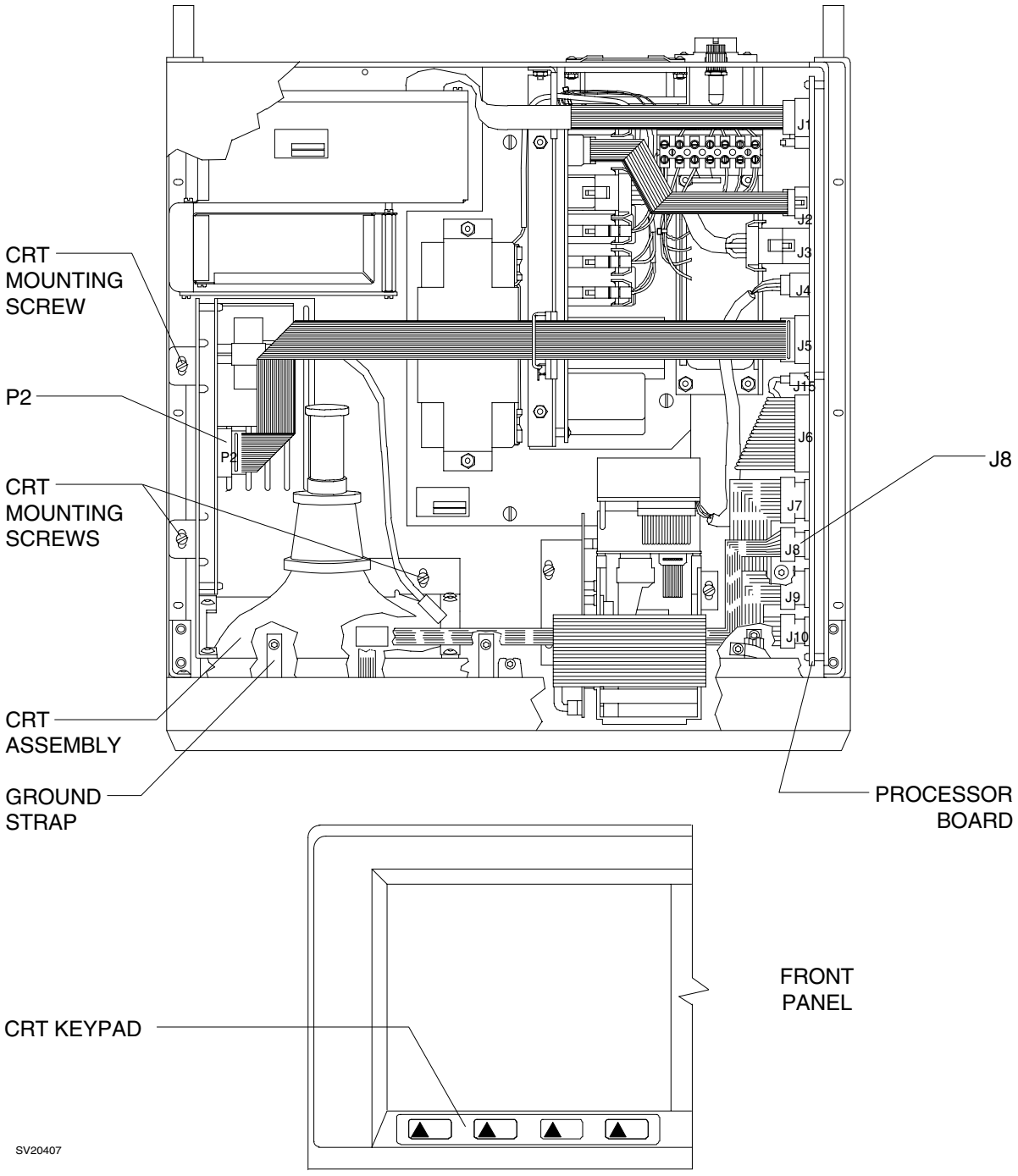


Figure 4-7: REPLACEMENT OF CRT KEYPAD

4.8 On/Standby Keypad

Replacement of the On/Standby Keypad requires removal of the VITALERT 2000 cover. Figure 4-8 shows the location of the keypad ground strap and the keypad flex cable connection to the processor board.

4.8.1 Remove the cover as outlined in Procedure 4.1.

4.8.2 Disconnect the On/Standby keypad from J10 on the processor board.

4.8.3 Remove the button head screw securing the On/Standby keypad ground strap.

4.8.4 Carefully peel the keypad from the bezel assembly and guide the flex cable through the bezel.

4.8.5 Thoroughly clean the surface where the new keypad will be installed.

4.8.6 Guide the new On/Standby keypad cable and ground strap through the holes in the bezel assembly.

4.8.7 Peel off the protective paper backing and firmly press the new On/Standby keypad into place.

4.8.8 Secure the keypad ground strap with the screw that was previously removed, and connect the flex cable to J10 on the processor board.

4.8.9 Reinstall the VITALERT 2000 cover.

4.8.10 Restore power to the instrument and exercise the On/Standby function to verify that the new keypad is working properly.

4.8.11 Perform the PMS Procedure given in Section 6.

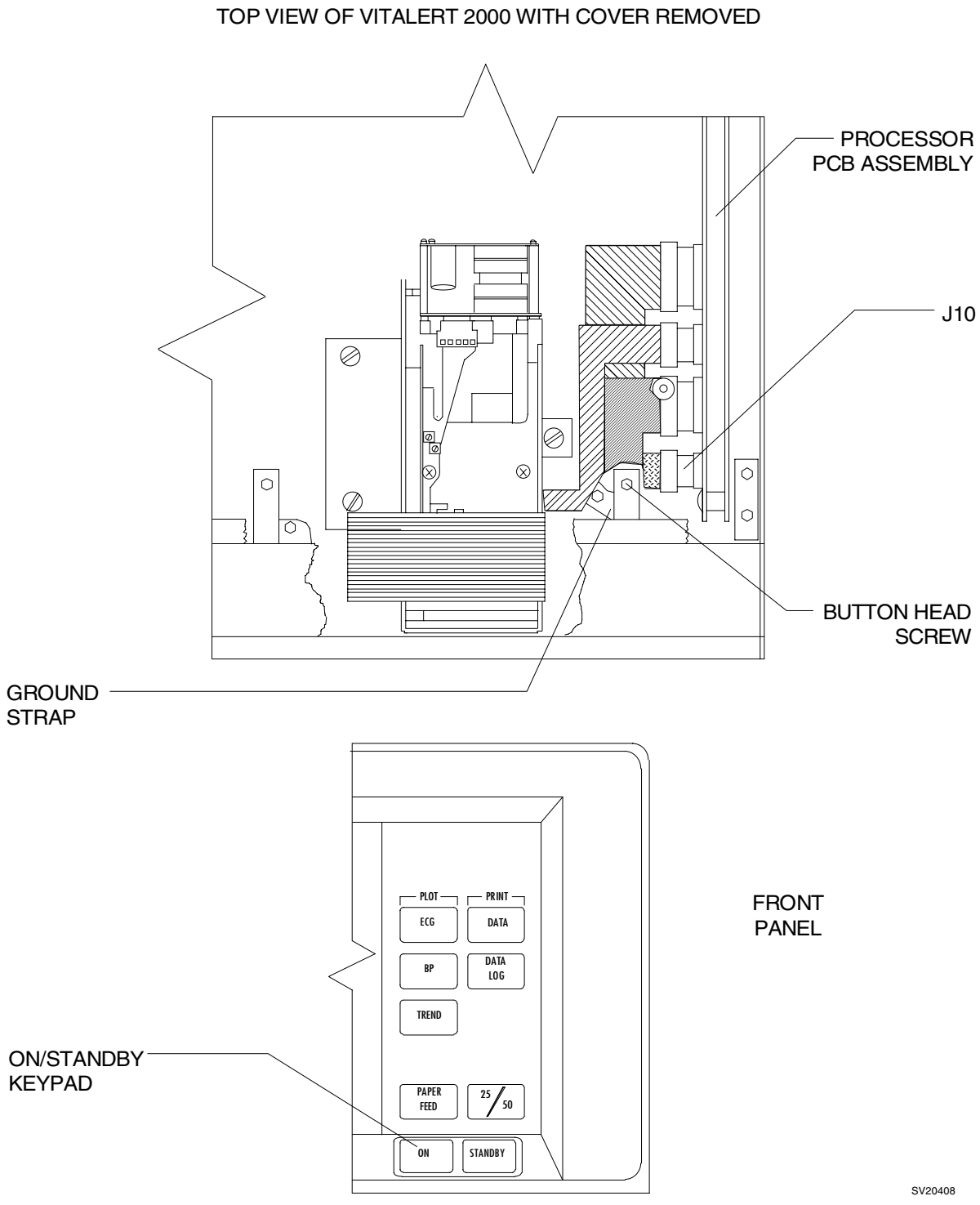


Figure 4-8: REPLACEMENT OF ON / STANDBY KEYPAD

4.9 Bezel Assembly

Replacement of the Bezel Assembly requires removal of the VITALERT 2000 cover, and removal of the CRT assembly. The Bezel Assembly includes the CRT Keypad, the On/Standby Keypad, the Strip Chart Recorder Keypad, and the Main Keypad & CRT filter assembly. Refer to the appropriate sub-section of this manual for individual keypad replacement instructions. Figure 4-9 shows the bezel mounting screw locations, keypad ground strap locations, and keypad cable connections to the processor board.

4.9.1 Remove the cover as outlined in procedure 4.1.

4.9.2 Disconnect the CRT cable from P2 on the CRT assembly.

4.9.3 Remove the three (3) screws securing the CRT assembly.

4.9.4 Carefully rotate the CRT assembly until it clears the DAU, and lift the CRT assembly from the chassis.

4.9.5 Remove the three button head screws securing the keypad ground straps.

4.9.6 Disconnect the keypad cables from J7, J8, J9, and J10 on the processor board.

4.9.7 Remove the button head screw holding the center of the bezel assembly to the chassis.

4.9.8 Remove the four screws (two on each side) holding the bezel mounting brackets to the chassis. These screws are accessible from the underside of the chassis.

4.9.9 Remove the mounting brackets from the bezel and transfer them to the replacement bezel assembly.

4.9.10 Route the CRT keypad cable under the strip chart recorder, and mount the bezel assembly to the chassis with the four screws that were previously removed.

4.9.11 Reinstall the screw and washer holding the center tab of the bezel to the chassis.

4.9.12 Secure the keypad ground straps with the three screws that were previously removed.

4.9.13 Connect the keypad cables to the processor board as follows:

Main Keypad to	J7	Recorder Keypad to	J9
CRT Keypad to	J8	On/Standby Keypad to	J10

4.9.14 Reinstall the CRT assembly with the three screws that were previously removed, and connect the CRT cable to P2 on the CRT assembly.

4.9.15 Reinstall the VITALERT 2000 cover.

4.9.16 Restore power to the instrument and verify that the keypads are functioning properly by performing the Keyboard Test in the Service Diagnostics Menu. See Section 2.

4.9.17 Perform the PMS Procedure given in Section 6.

TOP VIEW OF VITALERT 2000 WITH COVER REMOVED

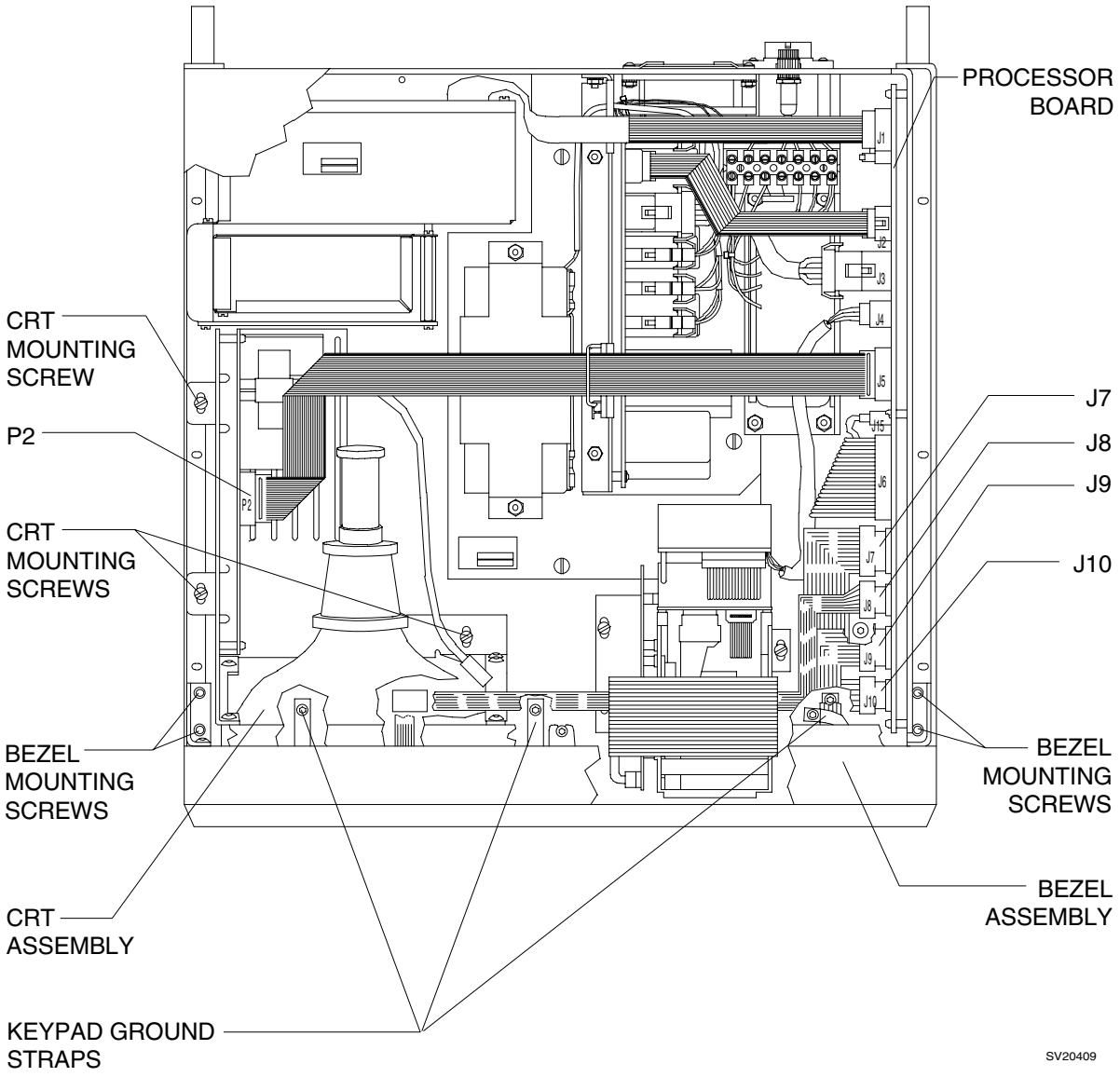


Figure 4-9: REPLACEMENT OF BEZEL ASSEMBLY

4.10 Main Keypad and CRT Filter Assembly

Replacement of the Main Keypad and CRT Filter Assembly requires removal of the VITALERT 2000 cover, and removal of the Bezel Assembly from the chassis. Figure 4-10 shows an inside view of the bezel and the keypad mounting arrangement.

4.10.1 Remove the Bezel Assembly as outlined in Procedure 4.9, steps 4.9.1 thru 4.9.8.

4.10.2 Remove the four screws holding the keypad retainer plate, and remove the Keypad and CRT Filter Assembly from the bezel.

4.10.3 Install the replacement keypad assembly on the bezel, and reinstall the Bezel Assembly as outlined in Procedure 4.9.

4.10.4 Reinstall the VITALERT 2000 cover.

4.10.5 Restore power to the instrument and verify that the keypads are functioning properly by performing the Keyboard Test in the Service Diagnostics Menu. See Section 2.

4.10.6 Perform the PMS Procedure given in Section 6.

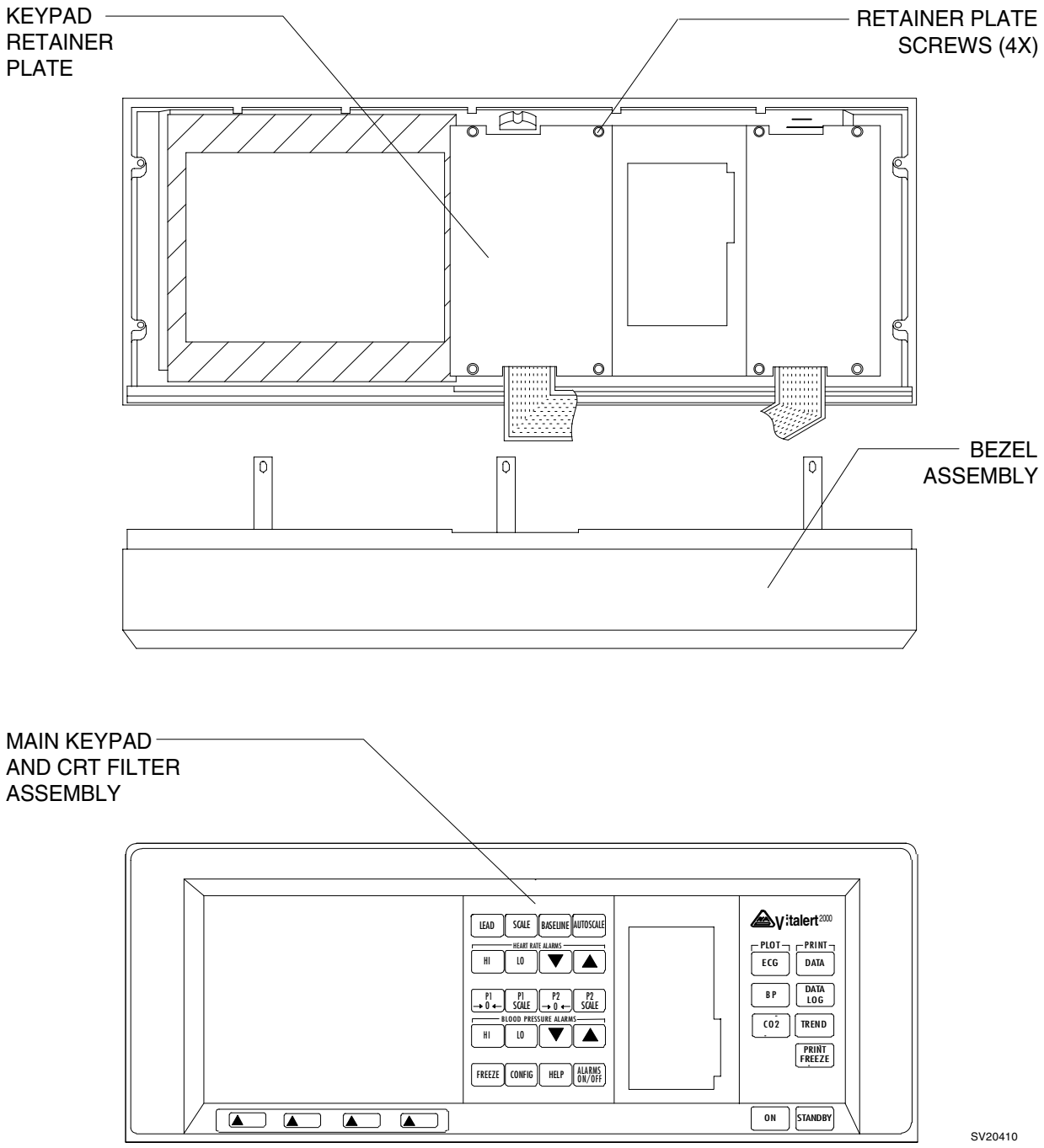


Figure 4-10: REPLACEMENT OF MAIN KEYPAD AND CRT FILTER ASSEMBLY

4.10A Strip Chart Recorder Keypad and Panel Assembly

Replacement of the Strip Chart Recorder Keypad and Panel Assembly requires removal of the VITALERT 2000 cover, and removal of the Bezel Assembly from the chassis. Figure 4-10A shows an inside view of the bezel and the keypad mounting arrangement.

4.10A.1 Remove the Bezel Assembly as outlined in Procedure 4.9, steps 4.9.1 thru 4.9.8.

4.10A.2 Remove the four screws holding the keypad retainer plate, and remove the Keypad and Panel Assembly from the bezel.

4.10A.3 Install the replacement keypad assembly on the bezel, and reinstall the Bezel Assembly as outlined in Procedure 4.9.

4.10A.4 Reinstall the VITALERT 2000 cover.

4.10A.5 Restore power to the instrument and verify that the keypads are functioning properly by performing the Keyboard Test in the Service Diagnostics Menu. See Section 2.

4.10A.6 Perform the PMS Procedure given in Section 6.

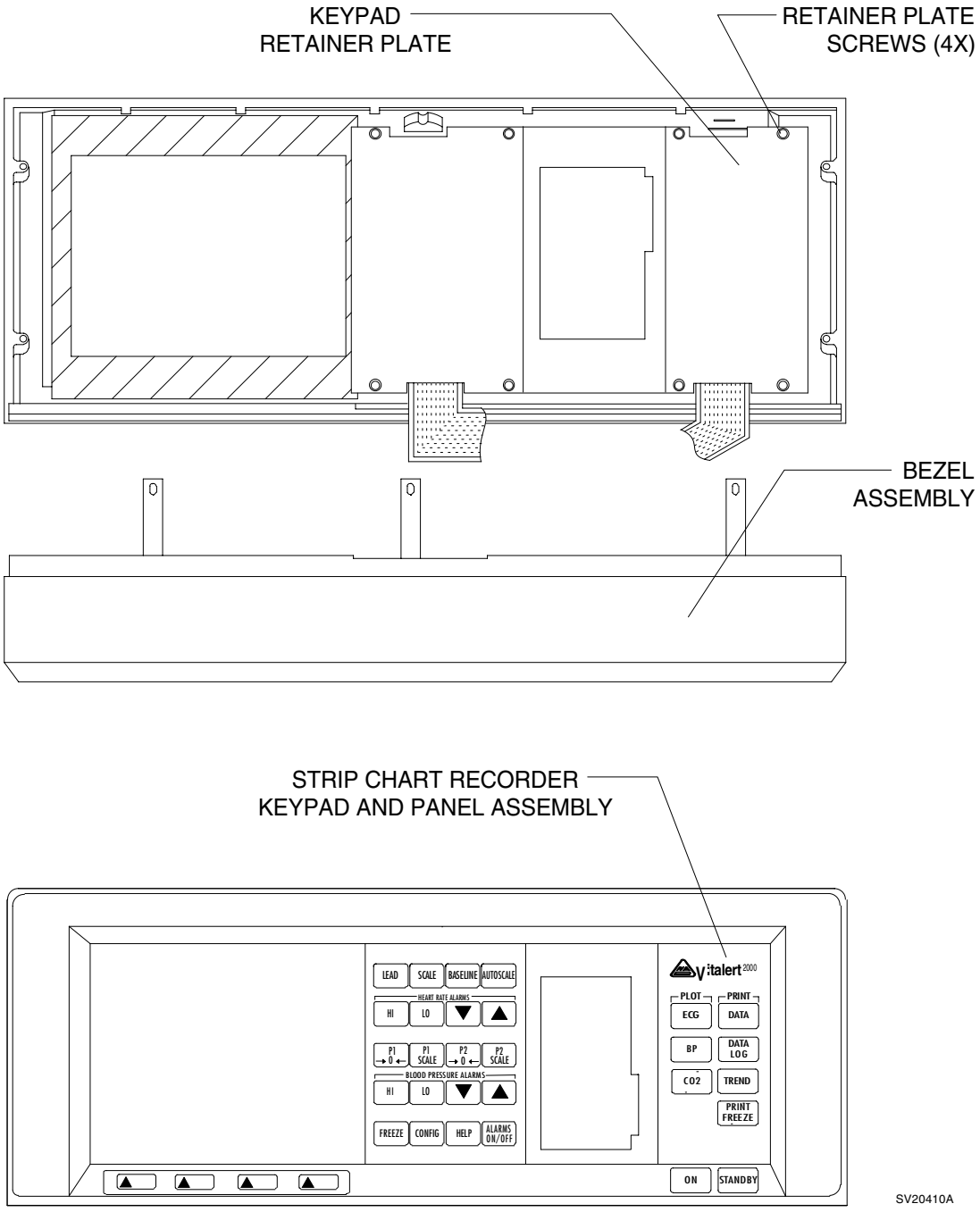


Figure 4-10A: REPLACEMENT OF RECORDER KEYPAD AND PANEL ASSEMBLY

4.11 Cables: Strip Chart Recorder Ribbon Cable (J6), CRT Ribbon Cable (J5), Power Supply Wire Harness (J3), Power Supply Ribbon Cable (J2)

Replacement of the internal cables requires removal of the VITALERT 2000 cover. Figure 4-11 shows the connector locations on the processor board and the routing of the internal replaceable cable assemblies.

4.11.1 Remove the cover as outlined in Procedure 4.1.

4.11.2 Disconnect each end of the cable and remove it from the chassis.

4.11.3 Connect each end of the replacement cable in the same manner as the original, and ensure that any keyed connectors are inserted correctly.

4.11.4 Reinstall the VITALERT 2000 cover, and restore power to the instrument.

4.11.5 Select the System Status Screen in the Service Diagnostics Menu and verify that all cables are connected. See Section 2.

4.11.6 Perform the PMS Procedure given in Section 6.

TOP VIEW OF VITALERT 2000 WITH COVER REMOVED

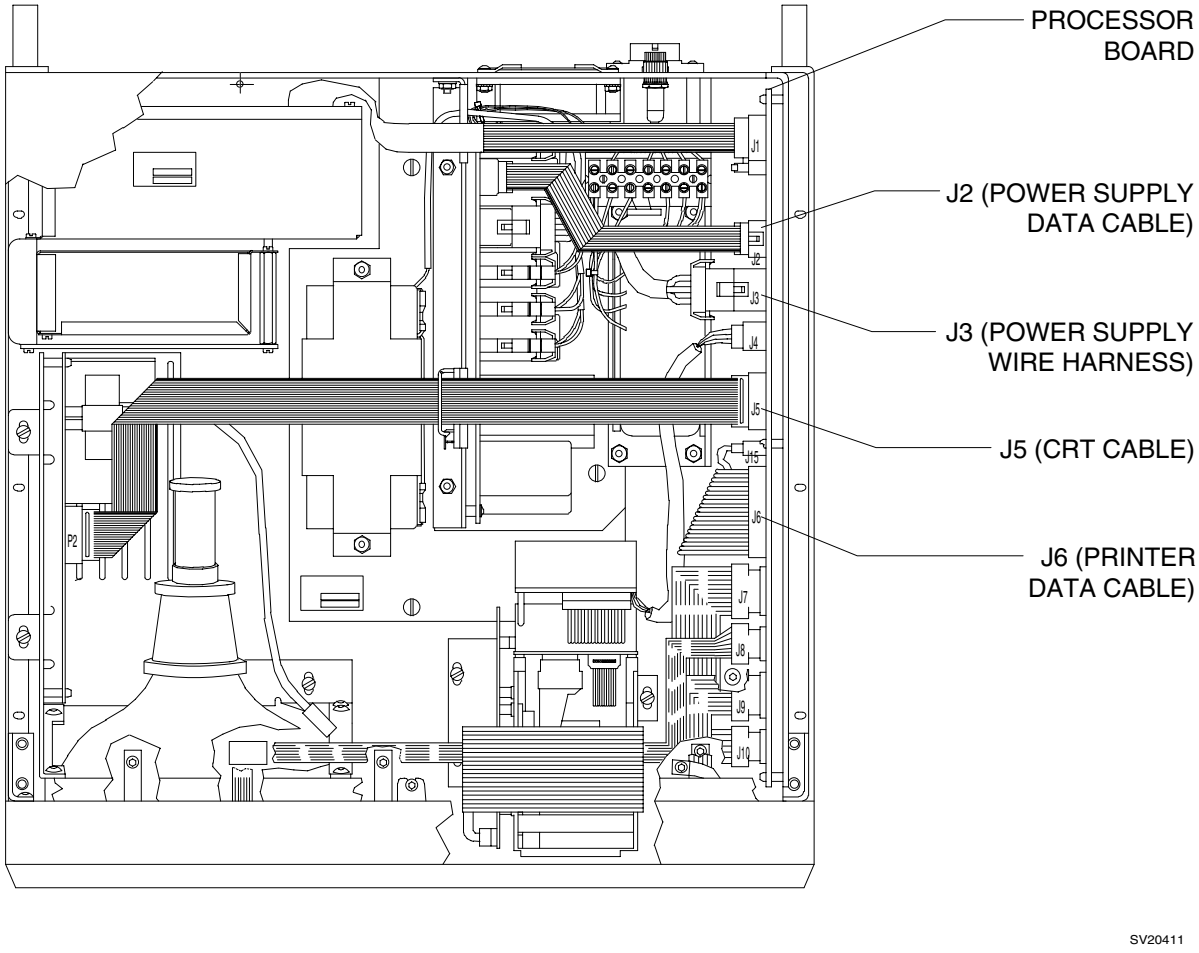


Figure 4-11: REPLACEMENT OF CABLES J2, J3, J5, J6

4.12 DAU - Processor Board (J1) Cable.

Replacement of the DAU - Processor Board Cable requires removal of the VITALERT 2000 cover, removal of the DAU from the chassis, and removal of the cover from the DAU. Figure 4-12 shows the detail of the cable connection within the DAU.

4.12.1 Remove the cover as outlined in Procedure 4.1.

4.12.2 Disconnect J1 at the processor board.

4.12.3 Carefully rotate the instrument onto its side.

4.12.4 Remove the four nuts securing the DAU assembly to the chassis. Hold the DAU assembly while removing the nuts so that the assembly does not fall from the chassis.

4.12.5 Remove the DAU assembly from the chassis.

4.12.6 Remove the four pan head screws securing the rear cover of the DAU assembly.

4.12.7 Disconnect the ribbon cable from J1 on the DAU assembly.

4.12.8 Connect the replacement cable to J1 on the DAU, and reinstall the DAU cover with the screws that were previously removed.

4.12.9 Carefully reinstall the DAU assembly in the chassis with the four nuts that were previously removed.

4.12.10 Carefully return the instrument to its normal position.

4.12.11 Connect the ribbon cable to J1 on the processor board.

4.12.12 Reinstall the VITALERT 2000 cover, and restore power to the instrument.

4.12.13 Verify that the new cable is functioning properly by viewing the System Status Screen in the Service Diagnostics Menu. See Section 2.

4.12.14 Perform the PMS Procedure given in Section 6.

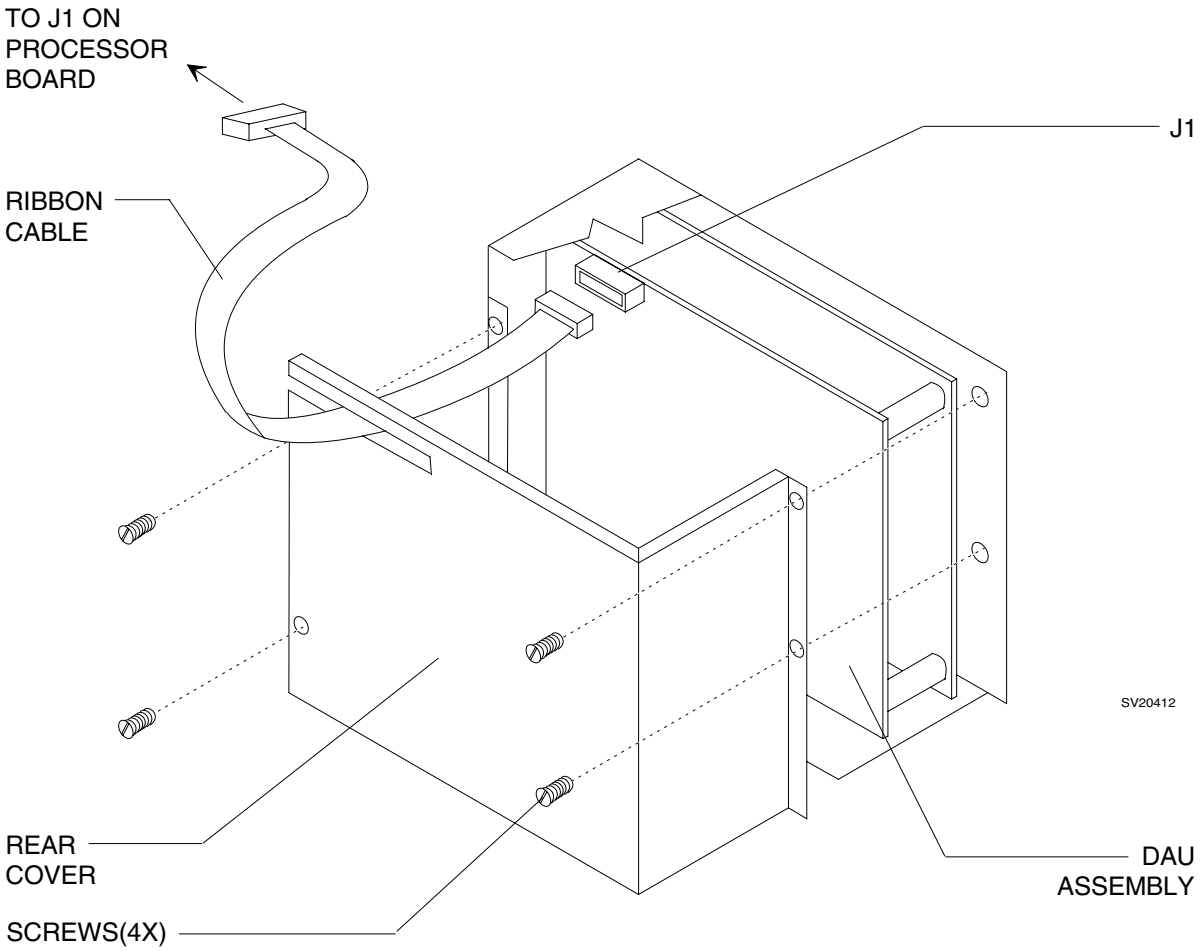


Figure 4-12: REPLACEMENT OF DAU - PROCESSOR BOARD CABLE

4.13 Battery Pack

Replacement of the Battery Pack requires removal of the VITALERT 2000 cover. The battery pack is made up of three 6-volt rechargeable batteries connected in series. It is located on the power supply assembly and is held in place by a retainer bracket. Figure 4-13 shows the battery mounting arrangement and wire harness connections.

4.13.1 Remove the cover as outlined in Procedure 4.1.

4.13.2 Disconnect the DAU-to-processor board cable from J1 on the processor board.

4.13.3 Disconnect the power supply-to-processor board cable from J5 on the power supply PCB assembly.

4.13.4 Disconnect the battery wire harness from J3 on the power supply PCB assembly.

4.13.5 Remove the two battery retainer nuts, and lift out the battery retainer.

4.13.6 Lift the battery pack from the power supply assembly.

4.13.7 Position the replacement battery pack in the power supply assembly, reinstall the retainer bracket and secure it with the two nuts that were previously removed.

4.13.8 Connect the battery wire harness to J3 on the power supply PCB assembly.

4.13.9 Connect the power supply-to-processor board cable to J5 on the power supply PCB assembly.

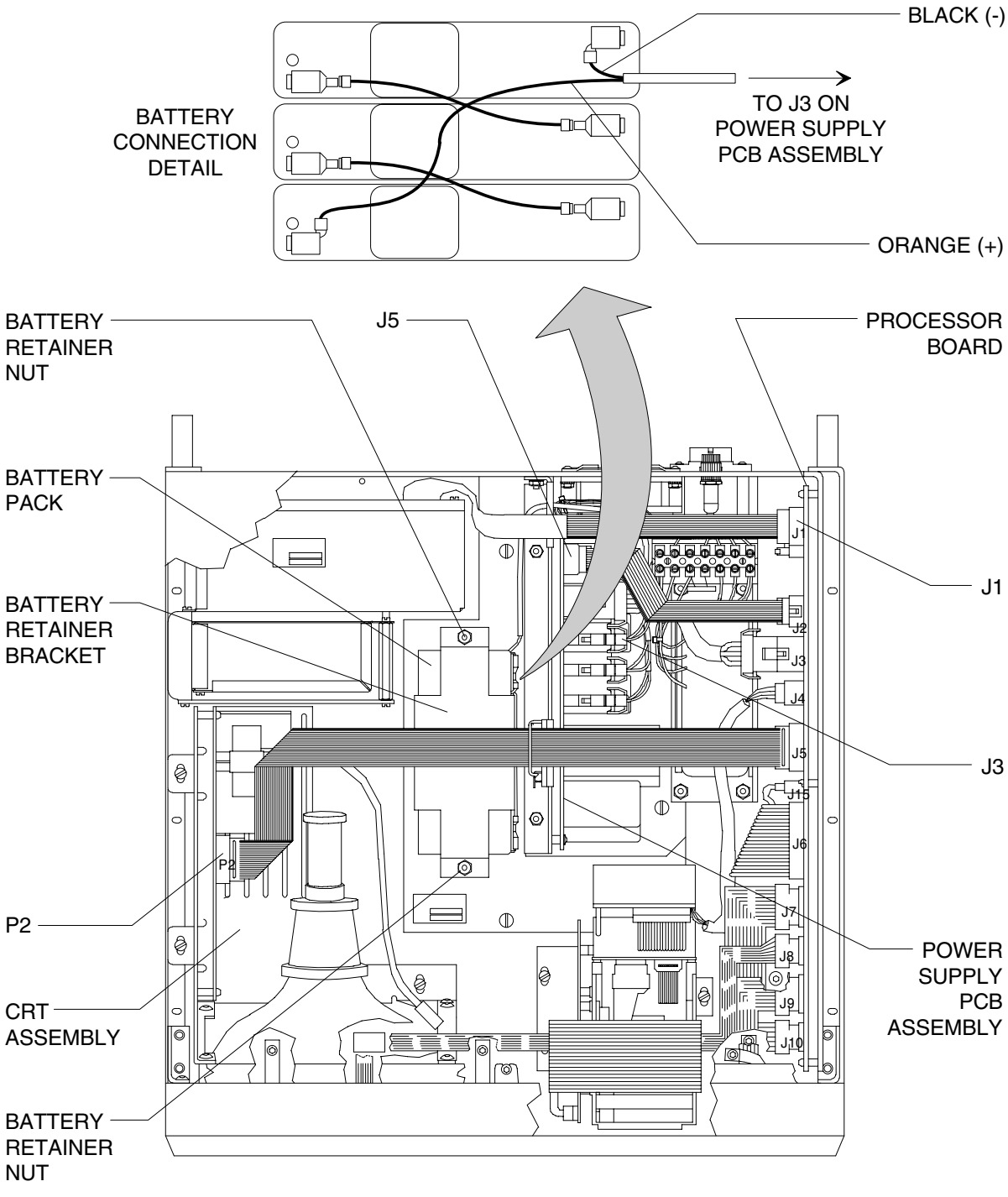
4.13.10 Connect the DAU-to-processor board cable to J1 on the processor board.

4.13.11 Reinstall the VITALERT 2000 cover.

4.13.12 Restore power to the instrument and allow the battery to charge for several hours.

4.13.13 Verify that the battery voltage is within the allowable tolerance by viewing the System Status Screen in the Service Diagnostics Menu. See Section 2.

4.13.14 Perform the PMS Procedure given in Section 6.



TOP VIEW OF VITALERT 2000 WITH COVER REMOVED

Figure 4-13: BATTERY REPLACEMENT

RETURN TO THIS MANUAL'S TABLE OF CONTENTS
RETURN TO CD-ROM TABLE OF CONTENTS

5.0 ADJUSTMENT AND CALIBRATION PROCEDURES

Recommended Equipment for Calibration Procedures

Pressure: Fogg BP-28 Transducer Simulator with Fogg 30/NAD-1 pressure adapter cable

Temperature: Fogg TP400/700 Temperature Probe Simulator with Fogg 7242-0001 Temperature adapter cable

ECG: Fogg M-310 with 7147-0050 Memory Module, NAD 4110553 P ECG cable, and NAD 4110984 A ECG lead sets

CRT: Non-metallic Alignment Tools

5.1 CRT Adjustment

5.1.1 Remove the VITALERT 2000 cover as outlined in Procedure 4.1.

5.1.2 Enter the Service Diagnostics menu and select CRT Geometry. See Section 2.

5.1.3 Following is the CRT alignment procedure using the geometric pattern on the screen as a reference. Figure 5-1 shows the locations of the CRT adjustments on Wells Gardner assemblies. With the exception of horizontal width, the adjustments shall be done from the exterior side of the CRT assembly through the access holes in the chassis.

Figure 5-1A shows the locations of adjustments on later model Wells Gardner assemblies. The vertical centering and focus adjustments can be made through access holes in the chassis; the other adjustments must be made from the component side of the circuit board.

Figure 5-2 shows the locations of the CRT adjustments on Computron assemblies. These adjustments must be made from the component side of the circuit board. Reference designations in parenthesis apply to Computron assemblies.

5.1.3.1 Turn R79 (VR100), contrast control, fully clockwise.

5.1.3.2 Turn R1 (VR501), master brightness, fully clockwise.

5.1.3.3 Turn R1 (VR501), master brightness, counter-clockwise until the raster lines disappear.

5.1.3.4 Turn R79 (VR100), contrast control, to the eleven o'clock position as viewed from the exterior.

5.1.3.5 Adjust R12 (VR402), vertical linearity control, for equal height on all of the boxes.

5.1.3.6 Adjust R10 (VR401), vertical height control, for a 3.75" frame height.

5.1.3.7 Adjust L2 (Ind), horizontal width control (located on the interior side of the CRT assembly), for a 5.00" frame width.

5.1.3.8 Adjust R34 (VR300), horizontal centering control, to center the position of the pattern.

5.1.3.9 Adjust R48 (VR500), focus control, for minimum line width.

NOTE: A vertical hold control, R5, is provided on Wells Gardner units.

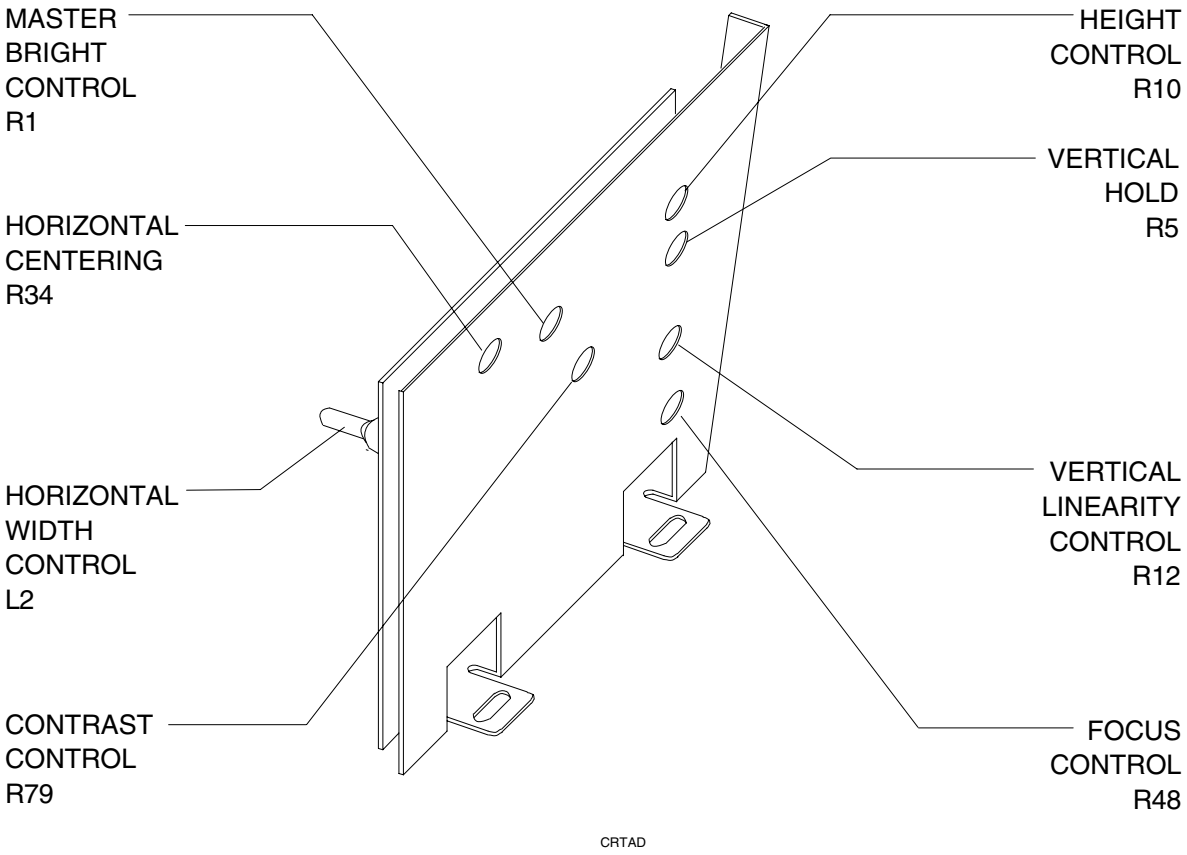


Figure 5-1: WELLS GARDNER CRT ADJUSTMENTS (EARLY MODELS)

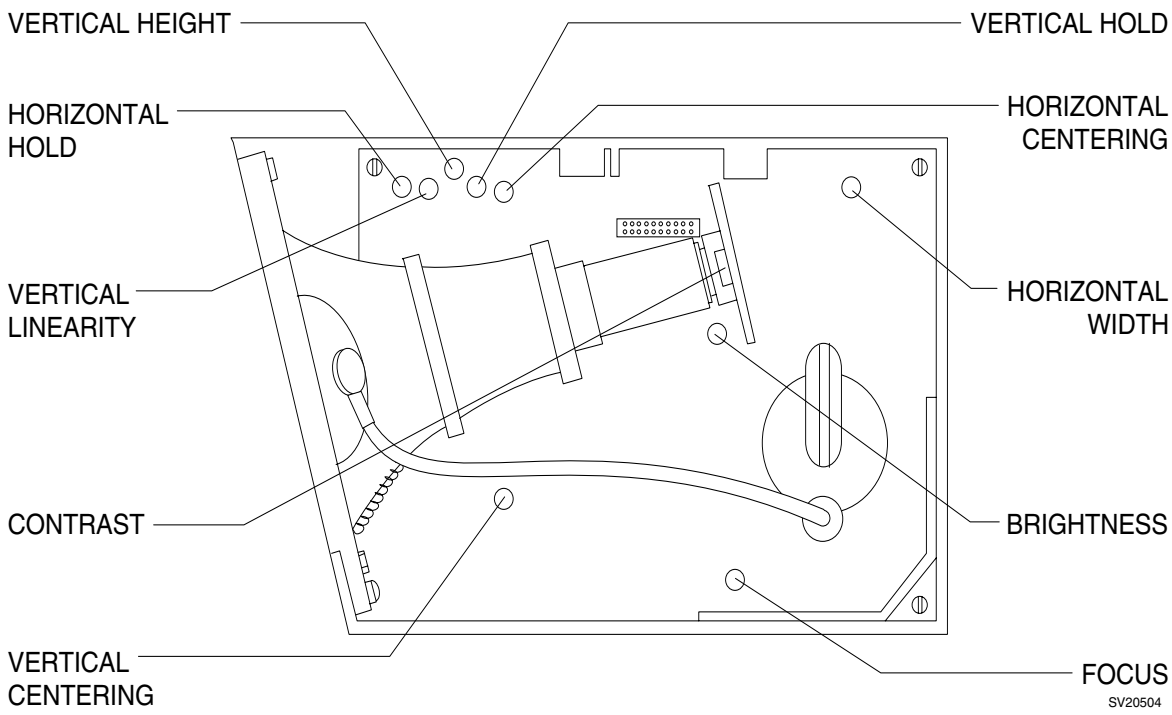


Figure 5-1A: WELLS GARDNER CRT ADJUSTMENTS (LATER MODELS)

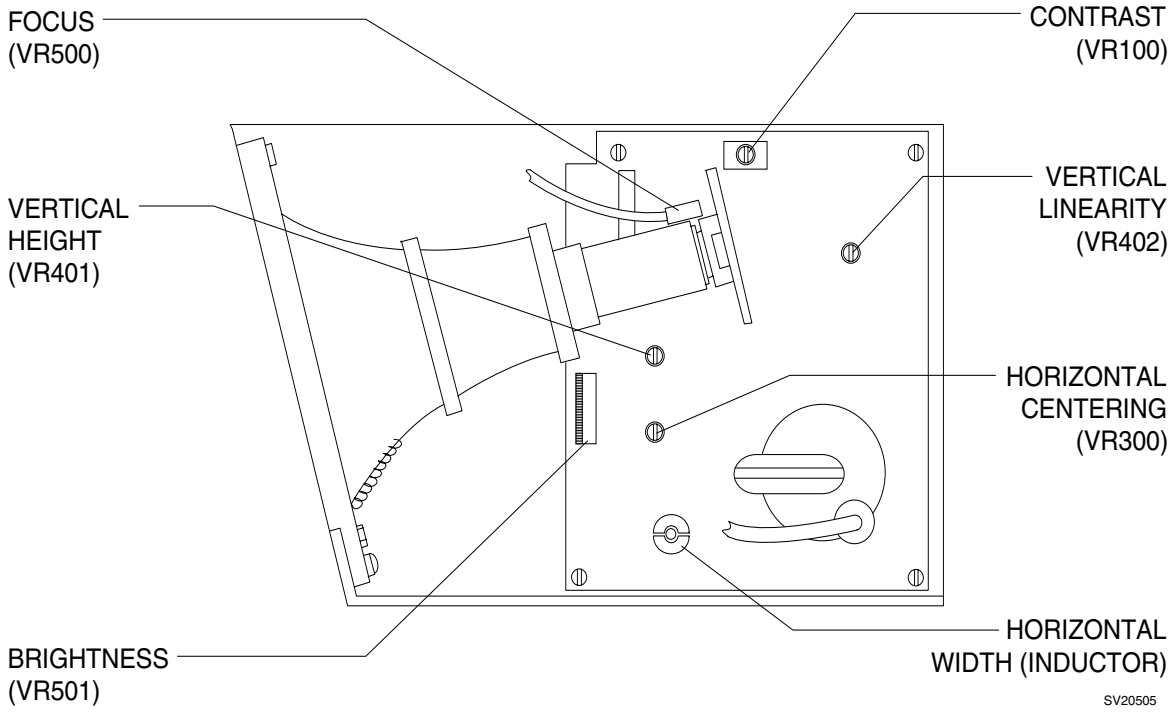


Figure 5-2: COMPUTRON CRT ADJUSTMENTS

5.2 Data Acquisition Unit Automatic and Manual Calibration

Do not attempt to calibrate the DAU before reading the entire DAU Calibration Procedure. Check the DAU Calibration Screen prior to calibrating the DAU. If the readings are within acceptable calibration ranges, do not perform a calibration. If the recommended equipment referred to in procedure 5.0 is not available, do not attempt to perform the DAU Automatic Calibration; perform the DAU Manual Calibration.

The following statements are valid at all times during a DAU Manual calibration:

- If a "DAU Calibration Error" message appears on the DAU Calibration Service Screen during an ongoing manual calibration, select the "RESTART CAL" menu option, then press the "ENTER" soft key. This option removes the "DAU Calibration Error" message from the screen; the TSR must then restart the OFFSET or GAIN procedure for the current signal being calibrated. All previous signals which have been calibrated are still correct.

- The "DAU CALIBRATION ERROR" message appears on the DAU Calibration Status Screen when the user enters an incorrect calibration sequence (see CALIBRATION PROCEDURE).

- At any point during a Manual Calibration, the new calibration constants can be stored by selecting the "STORE" option from the menu and pressing the "ENTER" key. If this is done, select the "RESET DATA" or "RESTART CAL" menu option, then press the "ENTER" key to clear the "TIMEOUT" error message.

NOTE: Before starting the DAU calibration, make sure the instrument is plugged into a live AC receptacle. Press the ON key. Press and hold the "CONFIG", "Heart Rate Alarm HI" keys, and the top right unlabeled key on the main keypad for a type 1 keypad, or the key labeled "AUTO SCALE" on a type 2 keypad, to enter the Service Diagnostics Menu. Select "DAU CALIBRATION", then press the "ENTER" key. The DAU Calibration Screen then appears on the CRT.

5.2.1 DAU AUTOMATIC CALIBRATION

5.2.1.1 Temperature Calibration

5.2.1.1.1 Insert the 400 series phone plug into the T1 input of the DAU.

5.2.1.1.2 Insert the 700 series phone plug into the T2 input of the DAU.

5.2.1.1.3 Set the temperature simulator to 68° F.

5.2.1.1.4 Select "T1 OFFSET at 68F", then press the "ENTER" key.

5.2.1.1.5 After the "T1 OFFSET CAL" message disappears, select "T2 OFFSET at 68F", then press the "ENTER" key.

5.2.1.1.6 After the "T2 OFFSET CAL" message disappears, set the temperature simulator to 104° F.

5.2.1.1.7 Select "T1 GAIN at 104F", then press the "ENTER" key.

5.2.1.1.8 After the "T1 GAIN CAL" message disappears, select "T2 GAIN at 104F", then press the "ENTER" key.

5.2.1.1.9 After the "T2 GAIN CAL" message disappears, remove the phone plugs from the DAU inputs.

5.2.1.1.10 Insert the 700 series phone plug into the T1 input of the DAU.

5.2.1.1.11 Insert the 400 series phone plug into the T2 input of the DAU.

5.2.1.1.12 Set the temperature simulator to 68° F.

5.2.1.1.13 Select "T1 OFFSET at 68F", then press the "ENTER" key.

5.2.1.1.14 After the "T1 OFFSET CAL" message disappears, select "T2 OFFSET at 68F", then press the "ENTER" key.

5.2.1.1.15 After the "T2 OFFSET CAL" message disappears, set the temperature simulator to 104° F.

5.2.1.1.16 Select "T1 GAIN at 104F", then press the "ENTER" key.

5.2.1.1.17 After the "T1 GAIN CAL" message disappears, select "T2 GAIN at 104F", then press the "ENTER" key.

5.2.1.1.18 Unless additional calibrations are required, select "STORE", then press the "ENTER" key.

5.2.1.2 Pressure Calibration

5.2.1.2.1 Insert the pressure transducer simulator plug into the P1 input of the DAU.

5.2.1.2.2 Set the simulator's POLARITY toggle switch to the ZERO position.

5.2.1.2.3 Select "P1 OFFSET at 0", then press the "ENTER" key.

5.2.1.2.4 After the "P1 OFFSET CAL" message disappears, set the pressure transducer simulator knob to 20/200 mm Hg, the POLARITY switch to the "POS" position, and the PRESSURE toggle switch to X10.

5.2.1.2.5 Select "P1 GAIN at 200", then press the "ENTER" key.

5.2.1.2.6 After the "P1 GAIN CAL" message disappears, remove the pressure transducer simulator plug from the P1 input and reinsert it into the P2 input of the DAU.

5.2.1.2.7 Set the simulator's POLARITY toggle switch to the ZERO position.

5.2.1.2.8 Select "P2 OFFSET at 0", then press the "ENTER" key.

5.2.1.2.9 After the "P2 OFFSET CAL" message disappears, set the pressure transducer simulator to 20/200 mm Hg, the POLARITY switch to the "POS" position, and the PRESSURE switch to X10.

5.2.1.2.10 Select "P2 GAIN at 200", then press the "ENTER" key.

5.2.1.2.11 Unless additional calibrations are required, select "STORE", then press the "ENTER" key.

5.2.1.3 ECG Signal Calibration

NOTE: For the following test, connect the ECG leads to the ECG simulator as outlined in the following table.

ECG LEAD	SIMULATOR POST
WHITE	WHITE
BLACK	**RED**
RED	**BLACK**
BROWN	BROWN
GREEN	GREEN

IMPORTANT!!
ENSURE THAT **BLACK** AND **RED** LEADS ARE CONNECTED AS INDICATED.

5.2.1.3.1 Insert the ECG cable plug into the VA2000 DAU ECG input.

5.2.1.3.2 Place the ECG simulator power switch to the "BATTERY" position.

NOTE: If the green LED does not flash, replace the batteries in the simulator before proceeding.

5.2.1.3.3 Turn the BPM "RATE" knob and the "AMPLITUDE" knob on the ECG Simulator fully counter-clockwise.

5.2.1.3.4 Select "ECG at 0mv", then press the "ENTER" key.

5.2.1.3.5 After the "ECG OFFSET CAL" message disappears, rotate the BPM "RATE" knob to the "300" position.

5.2.1.3.6 On the ECG simulator, set the toggle switches to "B", "W", and "X1".

5.2.1.3.7 Adjust the amplitude on the simulator to 1 mV.

5.2.1.3.8 Select "ECG 2mv DELTA", then press the "ENTER" key.

5.2.1.3.9 After the "ECG GAIN CAL" message disappears, select "STORE", then press the "ENTER" key.

Once all of the calibration procedures have been verified, and the calibration values are stored, the screen will reset and the calibrations will all be locked into memory. Finally, exit to the MONITOR SCREEN.

5.2.2 DAU MANUAL CALIBRATION

Before beginning the following procedure, select and enter the MANUAL MENU option on the DAU Calibration Screen as shown in Figure 5-3.

5.2.2.1 T1 and T2 Offset Calibration

5.2.2.1.1 Insert a 400 YSI Series Temperature Plug into the T1 input of the DAU and set the Temperature Simulator (resistor) at 68° F.

5.2.2.1.2 Select "T1 OFFSET CAL", then press the "ENTER" key.

5.2.2.1.3 Select "RE - INIT VALUE", then press the "ENTER" key.

5.2.2.1.4 Verify that the T1 reading on the DAU Status Screen equals 68.0° F. If necessary, use the INC Value or DEC Value menu option to raise or lower the value to 68.0° F.

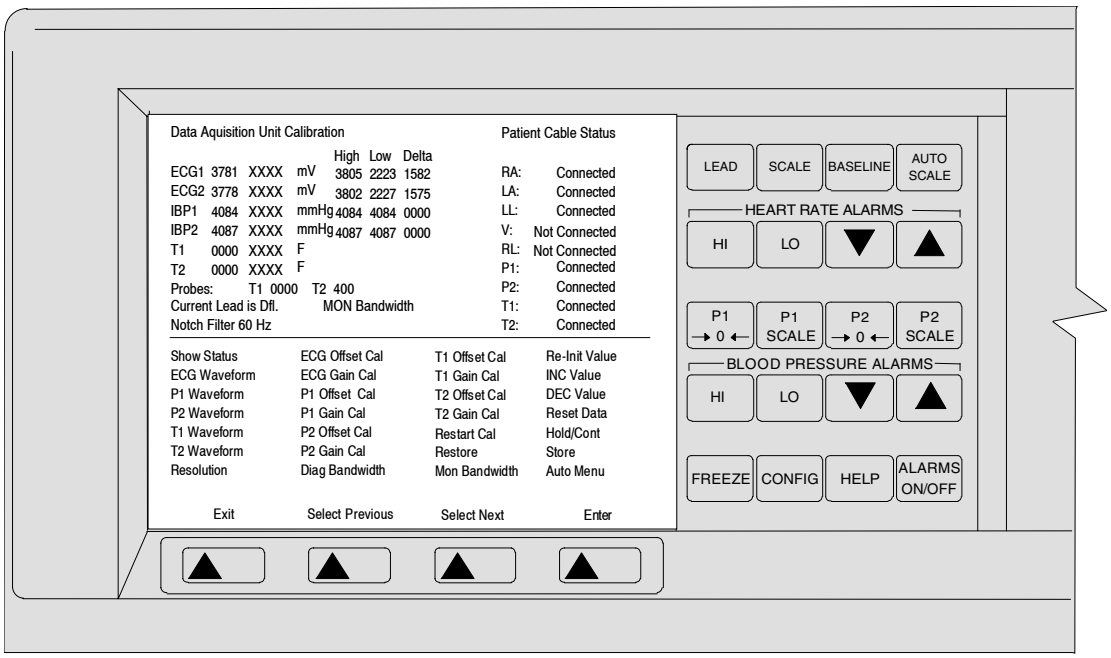


Figure 5-3: DAU MANUAL CALIBRATION SCREEN

5.2.2.2 T1 and T2 Gain Calibration

5.2.2.2.1 Set the Temperature Simulator to 40° C.

5.2.2.2.2 Select "T1 GAIN CAL", then press the "ENTER" key.

5.2.2.2.3 Select "RE - INIT VALUE", then press the "ENTER" key.

5.2.2.2.4 Verify that the T1 reading on the DAU Status Screen equals 104.0° F. If necessary, use the INC Value or DEC Value menu options to raise or lower the value to 104.0° F.

NOTE: Repeat the T1 offset and gain calibration procedures using the 700 YSI Series Temperature Plug. After the procedure is complete for T1, repeat for T2.

5.2.2.3 P1 and P2 Offset Calibration

5.2.2.3.1 Insert a Pressure Transducer Simulator into the P1 input of the DAU and set the Simulator to 0 mm Hg.

5.2.2.3.2 Select "P1 OFFSET CAL", then press the "ENTER" key.

5.2.2.3.3 Select "RE - INIT VALUE", then press the "ENTER" key.

5.2.2.3.4 Verify that the P1 value on the DAU Status Screen equals 000.0 mm Hg. If necessary, use the INC Value or DEC Value to raise or lower the value to 000.0 mm Hg.

5.2.2.4 P1 and P2 Gain Calibration

5.2.2.4.1 Set the Pressure Transducer Simulator to 200 mm Hg.

5.2.2.4.2 Select "P1 GAIN CAL", then press the "ENTER" key.

5.2.2.4.3 Select "RE - INIT CAL", then press the "ENTER" key.

5.2.2.4.4 Verify that the IBP1/IBP2 value on the DAU Status Screen equals 200 mm Hg. If necessary, use the INC Value or DEC Value to raise or lower the value to 200.0 mm Hg.

NOTE: Repeat the offset and gain calibration procedures for P2.

5.2.2.5 ECG Signal Offset Calibration

NOTE: For the following test, connect the ECG leads to the ECG simulator as outlined in the following table.

ECG LEAD	SIMULATOR POST
WHITE	WHITE
BLACK	**RED**
RED	**BLACK**
BROWN	BROWN
GREEN	GREEN

IMPORTANT!!
ENSURE THAT **BLACK** AND **RED** LEADS ARE CONNECTED AS INDICATED.

5.2.2.5.1 Connect the ECG leads to the ECG Simulator.

5.2.2.5.2 Connect the ECG cable plug into the VA2000 DAU ECG input.

5.2.2.5.3 Select "ECG WAVEFORM", then press the "ENTER" key.

5.2.2.5.4 Select "ADJUST RESOLUTION", then repeatedly press the "ENTER" key until the scale with the following values appears:

2428
2238
2048
1858
1668

5.2.2.5.5 Select "ECG OFFSET CAL", then press the "ENTER" key.

5.2.2.5.6 Place the ECG Simulator Power Switch to the "BATTERY" position.

NOTE: If the green LED does not flash, replace the batteries in the simulator before proceeding.

5.2.2.5.7 Turn the BPM "RATE" knob on the ECG Simulator fully counterclockwise.

5.2.2.5.8 Select "RE - INIT VALUE", then press the "ENTER" key.

5.2.2.5.9 Look at the ECG WAVEFORM SCREEN and verify that the horizontal line approximately bisects the 2048 marker. If necessary, use the INC or DEC key to raise or lower the line until it bisects the 2048 marker as illustrated below.

5.2.2.5.10 To verify the ECG Calibration select "SHOW STATUS", then press the "ENTER" key.

5.2.2.5.11 The ECG1 High reading should be 2052 ±4 counts. The ECG1 Low reading should be 2044 ±4 counts. If either of these are not within the given bounds, the ECG must be readjusted (i.e. return to the ECG WAVEFORM screen and continue adjusting the waveform).

Remember, the screen can be redrawn by pressing the "RESET SCREEN DATA" key.

5.2.2.6 ECG Signal Gain Calibration

5.2.2.6.1 Adjust the ECG Simulator heart rate to 300 BPM.

5.2.2.6.2 Adjust the amplitude (knob located on the rear of the simulator) to 1 mV.

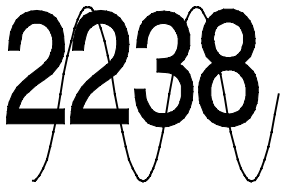
5.2.2.6.3 Configure the front panel toggle switches to the following (from left to right) positions: B, W, ×1.

5.2.2.6.4 Select "ECG GAIN CAL", then press the "ENTER" key.

5.2.2.6.5 Select "RE - INIT VALUE", then press the "ENTER" key.

5.2.2.6.6 Select "ECG WAVEFORM", then press the "ENTER" key.

5.2.2.6.7 Verify that the peaks of the sine waves are level with the top of the 2238 marking. If they are not, use the INC or DEC keys to raise or lower the peaks till they are level with the top of the 2238 marking.



5.2.2.6.8 To verify the ECG Gain Calibration, select "SHOW STATUS", then press the ENTER key.

5.2.2.6.9 If the difference in values between ECG1 High and ECG1 Low is not 380 ± 8 counts, return to the waveform screen and adjust the waveform as necessary.

Before saving the calibration constants, check the DAU TEST screen and verify that all values are within the specifications given in the above procedures. If they are not, recalibrate the appropriate signals.

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6.0 PMS PROCEDURE

The procedures in this section shall be performed in their entirety each time a component is removed, replaced, calibrated or adjusted, and during all scheduled Periodic Manufacturer's Service (PMS) visits. A PMS Checklist form is illustrated at the end of this section. The form can be used with either a Biotek Model 370 safety analyzer, or with a Biotek Model 501 safety analyzer. The form shall be completed by the Technical Service Representative each time a PMS is performed. The section numbers on the PMS Checklist form are keyed to paragraph numbers in this service manual. These forms are available from the North American Dräger Service Department.

NOTE: Verify the dates on test equipment calibration labels. DO NOT USE any test equipment having an expired calibration date. Notify your supervisor immediately if any equipment is found to be out of calibration.

In the space provided at the bottom of the PMS checklist form, record the Model and EL number of all calibrated test equipment used. Examples are: multimeter, safety analyzer, simulators.

Recommended Equipment for Periodic Manufacturer's Service:

Safety Testing: Biotek Model 501 or Model 370 Safety Analyzer

Pressure: Fogg BP-28 Transducer Simulator with Fogg 30/NAD-1 pressure adapter cable

Temperature: Fogg TP400/700 Temperature Probe Simulator with Fogg 7242-0001 Temperature adapter cable

ECG: Fogg M-310 with 7147-0050 Memory Module, NAD 4110553 ECG cable, and NAD 4110984 ECG lead sets

NOTE: If substitute test equipment is used, refer to the operator's manual of that equipment for proper application.

NOTE: Section 6.2A applies when using a Biotek Model 501 Safety Analyzer; Section 6.2B applies when using a Biotek Model 370 Safety Analyzer. Be sure to make entries in the appropriate places on the PMS Checklist.

6.1 Circuit Isolation Test

6.1.1 Verify that the VA2000 is in the Standby mode; remove all cables and the power cord from the VA2000.

6.1.2 Disable CB1 and CB2 on the rear panel of the VA2000.

6.1.3 Remove the VA2000 cover.

6.1.4 Set a multimeter to its highest resistance range, check for continuity between the power supply chassis and the bottom of resistor R1 on the power supply PCB. Record the reading on the PMS form. > 20 Megohms.

6.1.5 Disconnect the multimeter, reinstall the VA2000 cover.

6.1.6 Re-enable CB1 and CB2, and reinstall the AC power cord.

6.2A Safety Testing (Biotek Model 501)

6.2.1A Chassis Resistance Testing

NOTE: Do not plug the Biotek 501 Pro safety analyzer power cord into a line isolation monitor as inaccurate readings may occur.

6.2.1.1A Plug the Biotek 501 Pro power cord into a live AC receptacle, place the power switch of the Biotek 501 Pro to the "1" or ON position and ensure that the keys marked "GROUND", "NEUTRAL" and "POLARITY" are in the NORMAL position.

NOTE: If the corresponding red LEDs for GND, NEU, and POL are not lighted, they are in the normal position.

6.2.1.2A Attach the ground lead from the red "Test Lead" input to the ground hole of the AC test receptacle on the Biotek 501 Pro. Select the "Single Lead" condition by ensuring that the "SINGLE/DUAL" key is not illuminated. Press the gray key marked "RESIST", then press the blue key marked "CAL". When the word CAL is no longer shown in the display window of the Biotek 501 Pro, you may proceed.

6.2.1.3A Remove the red lead from the ground hole of the AC test receptacle and attach the alligator clip to the free end, leaving the other end plugged into the red "Test Lead" input of the Biotek 501 Pro with the "Single Lead" and "Resistance" conditions still selected.

Attach the alligator clip to the metal housing of the serial port on the VA2000.

NOTE: For export models, use the 220 volt test receptacle located on the back of the Biotek 501 (if so equipped).

6.2.1.4A With the VA2000 in the Standby mode, plug the VA2000 power cord into the test receptacle of the Biotek 501 Pro. The resistance reading then shown on the Biotek 501 Pro display is the "Chassis Resistance". Bend and exercise the power cord to check for intermittent readings. Record the reading on the PMS form. (≤ 0.1 ohm)

6.2.2A Chassis Leakage Testing

6.2.2.1A Press the gray "LEAKAGE" key, leaving all other selections from the previous test the same.

6.2.2.2A Turn the VA2000 ON and allow the unit to Complete its self test.

6.2.2.3A Set up the Biotek 501 Pro by using the white keys labeled "Ground", "Neutral" and "Polarity" for normal ground, normal neutral and normal polarity. Record the reading on the PMS form. (0 µA)

6.2.2.4A Set the white keys for normal ground, open neutral and normal polarity. Record the reading on the PMS form. (0 µA)

6.2.2.5A Set the white keys for open ground, normal neutral and normal polarity. Record the reading on the PMS form. (≤ 30 µA but not 0) Export: (≤60 µA but not 0)

6.2.2.6A Set the VA2000 to the STANDBY mode and set the white keys of the Biotek 501 Pro for normal ground, normal neutral and reverse polarity.

6.2.2.7A Return the VA2000 to the ON mode and allow completion of the self test. Record the reading on the PMS form. (0 µA)

6.2.2.8A Set the white keys for normal ground, open neutral and reverse polarity. Record the reading on the PMS form. (0 µA)

6.2.2.9A Set the white keys for open ground, normal neutral and reverse polarity. Record the reading on the PMS form. (≤ 30 µA but not 0) Export: (≤60 µA but not 0)

6.2.2.10A Return the VA2000 to the STANDBY mode, and then return the white keys on the Biotek 501 Pro to the Normal positions.

6.2.3A Lead Isolation Factor

6.2.3.1A Select the blue "ECG LEAK" key on the Biotek 501 Pro.

6.2.3.2A Use the Increment or Decrement arrow key on the Biotek 501 Pro to select the "ALL-GND" option.

CAUTION: During this testing, DO NOT touch the ECG posts of the Biotek 501 Pro.

6.2.3.3A Push and hold the pink key of the Biotek 501 Pro marked "ISOLATION". Record the reading from the display (referred to as the Lead Isolation Factor) on the PMS form.

6.2.3.4A Release the "ISOLATION" key.

6.2.4A ECG Leakage Testing

6.2.4.1A Connect the leads of the ECG cable (by color) to the posts on the Biotek 501 Pro.

6.2.4.2A Insert the ECG cable plug into the ECG input of the VA2000 DAU interface.

6.2.4.3A Turn the VA2000 ON and allow completion of the self test.

6.2.4.4A Verify that the blue "ECG LEAK" key and "ALL-GND" are still selected on the Biotek 501 Pro.

6.2.4.5A Set up the Biotek 501 Pro by using the white keys again, for normal ground, normal neutral and normal polarity. Record the reading on the PMS form. (0 µA)

6.2.4.6A Set up the white keys for normal ground, open neutral and normal polarity. Record the reading on the PMS form. (0 µA)

6.2.4.7A Set up the white keys for open ground, normal neutral and normal polarity. Record the reading on the PMS form. (≤ 10 µA but not 0)

6.2.4.8A Set the VA2000 to the STANDBY mode and set up the white keys of the Biotek 501 Pro for normal ground, normal neutral and reverse polarity.

6.2.4.9A Return the VA2000 to the ON mode and allow completion of the self test. Record the reading on the PMS form. (0 µA)

6.2.4.10A Set up the white keys for normal ground, open neutral and reverse polarity. Record the reading on the PMS form. (0 µA)

6.2.4.11A Set up the white keys for open ground, normal neutral and reverse polarity. Record the reading on the PMS form. (≤ 10 µA but not 0)

6.2.4.12A Return the VA2000 to the STANDBY mode and then return the Biotek 501 Pro white keys to their normal positions.

6.2.4.13A Turn the VA2000 ON and allow completion of the self test.

CAUTION: During this testing, DO NOT touch the ECG posts of the Biotek 501 Pro.

6.2.4.14A Push and hold the pink key of the Biotek 501 Pro marked "ISOLATION". Subtract the Lead Isolation Factor value previously recorded, from the value now being displayed. The difference is "Lead Isolation" which shall not exceed 20 µA. Record the reading on the PMS form. ≤ 20 µA.

6.2.4.15A Release the "ISOLATION" key, power down both the VA2000 and the safety analyzer, remove all connections between the VA2000 and the safety analyzer.

6.2B Safety Testing (Biotek Model 370)

6.2.1B Chassis Resistance Testing

NOTE: Do not plug the Biotek 370 safety analyzer power cord into a line isolation monitor, as inaccurate readings may occur.

6.2.1.1B Plug the Biotek 370 power cord into a live AC receptacle and set the Power switch of the Biotek 370 to the ON position.

6.2.1.2B Insert the double red lead set into the two red inputs marked "SINGLE LEADS" on the Biotek 370, and attach the red lead set alligator clip to the metal housing of the serial port on the VA2000.

6.2.1.3B Set the Biotek 370 Polarity switch to the OFF position, and the GROUND and NEUTRAL switches to NORMAL.

6.2.1.4B Set the Function Select knob to the "RESISTANCE" area with the "GROUND WIRE" selection made.

NOTE: Prior to using the Biotek 370 for 220 volt VA2000E electrical safety testing, ensure that the switch labeled LINE VOLTAGE located on the back of the Biotek 370 is in the "230" position.

The Biotek 370 Test Receptacle puts out 220 volts AC when the Biotek 370 is plugged into a 220 volt outlet.

6.2.1.5B With the VA2000 in the STANDBY mode, plug the VA2000 into the test receptacle of the Biotek 370. The reading then shown on the Biotek display is the "Chassis Resistance". Bend and exercise the power cord to check for intermittent readings. Record the reading on the PMS form. ≤ 0.1 ohm

6.2.2B Chassis Leakage Testing

6.2.2.1B Set the GROUND, NEUTRAL and POLARITY switches of the Biotek 370 to the NORMAL position.

6.2.2.2B Set the Function Select knob to the "LEAKAGE CURRENT" area with the CHASSIS selection made.

6.2.2.3B Turn the VA2000 ON and allow the self test to complete.

6.2.2.4B With the GROUND, NEUTRAL and POLARITY switches of the Biotek 370 set to the NORMAL position, view the display. Record the reading on the PMS form. (0 µA)

6.2.2.5B Set the switches for normal ground, open neutral and normal polarity. Record the reading on the PMS form. (0 µA)

6.2.2.6B Set the switches for open ground, normal neutral and normal polarity. Record the reading on the PMS form. (≤ 30 µA but not 0) Export: (≤60 µA but not 0)

6.2.2.7B Set the VA2000 to the STANDBY mode and set the switches of the Biotek 370 for normal ground, normal neutral and reverse polarity.

6.2.2.8B Return the VA2000 to the ON mode and allow completion of the self test. Record the reading on the PMS form. (0 µA)

6.2.2.9B Set the switches for normal ground, open neutral and reverse polarity. Record the reading on the PMS form. (0 µA)

6.2.2.10B Set the switches for open ground, normal neutral and reverse polarity. Record the reading on the PMS form. (≤ 30 µA but not 0) Export: (≤60 µA but not 0)

6.2.2.11B Return the VA2000 to the STANDBY mode and return the Biotek 370 Ground, Neutral and Polarity switches to their Normal positions.

6.2.3B Lead Isolation Factor

6.2.3.2B Set the Function Select knob of the Biotek 370 to the "ECG LEADS" selection within the "LEAKAGE CURRENT " area.

6.2.3.3B Depress the "ALL LEADS CONNECTED" push button.

CAUTION: During this testing, DO NOT touch the ECG posts of the Biotek 370.

6.2.3.4B Press and hold the "LEAD ISOLATION" button of the Biotek 370. Record the reading from the display (referred to as the Lead Isolation Factor) on the PMS form.

6.2.3.5B Release the Lead Isolation button.

6.2.4B ECG Leakage Testing

6.2.4.1B Connect the leads of an ECG cable (by color) to the corresponding posts on the Biotek 370.

6.2.4.2B Insert the ECG cable plug into the ECG input of the VA2000 DAU interface.

6.2.4.3B Turn the VA2000 ON and allow completion of the self test.

6.2.4.4B Verify that the "ECG LEADS" selection and the "ALL LEADS CONNECTED" push button are still selected on the Biotek 370.

6.2.4.5B With the Ground, Neutral and polarity switches of the Biotek 370 set to the NORMAL position, view the display. Record the reading on the PMS form. (0 µA)

6.2.4.6B Set the switches for normal ground, open neutral and normal polarity. Record the reading on the PMS form. (0 µA)

6.2.4.7B Set the switches for open ground, normal neutral and normal polarity. Record the reading on the PMS form. (≤ 10 µA but not 0)

6.2.4.8B Set the VA2000 to the STANDBY mode and set up the switches of the Biotek 370 for normal ground, normal neutral and reverse polarity.

6.2.4.9B Return the VA2000 to the ON mode and allow completion of the self test. Record the reading on the PMS form. (0 µA)

6.2.4.10B Set the switches for normal ground, open neutral and reverse polarity. Record the reading on the PMS form. (0 µA)

6.2.4.11B Set the switches for open ground, normal neutral and reverse polarity. Record the reading on the PMS form. (≤ 10 µA but not 0)

6.2.4.12B Return the VA2000 to the STANDBY mode, and then return the Biotek 370 Ground, Neutral and Polarity switches to their Normal positions.

6.2.4.13B Turn the VA2000 ON and allow completion of the self test.

CAUTION: During this testing, DO NOT touch the ECG posts of the Biotek 370.

6.2.4.14B Push and hold the "LEAD ISOLATION" button of the Biotek 370. Subtract the Lead Isolation Factor value previously recorded, from the value now being displayed. The difference is LEAD ISOLATION, which shall not exceen 20 µA. Record the reading on the PMS form. (≤ 20 µA)

6.2.4.15B Release the LEAD ISOLATION button, power down both the VA2000 and the safety analyzer, remove all connections between the VA2000 and the safety analyzer.

6.3 Service Screen

6.3.1 Plug the VA2000 into a grounded 120 VAC outlet. Press the "ON" key.

6.3.2 Verify that the correct software version number is displayed in the upper right hand corner of the CRT. Record this number.

6.3.3 Verify that all the diagnostics are labeled PASS and that the unit is FUNCTIONAL.

6.3.4 Press the "CONFIG" key to enter the Configuration Screen. Press and hold simultaneously the "CONFIG", "Heart Rate Alarm HI" and the unlabeled top right key on the main keypad for a Type 1 keypad, or the key labeled "AUTO SCALE" on a Type 2 keypad.

6.3.5 Select and enter the System Status screen.

6.3.6 Verify that all entries under INTERNAL CABLE STATUS are labeled CONNECTED.

6.3.7 Verify that all entries under EXTERNAL CABLE STATUS are labeled DISCONNECTED.

6.3.8 Verify that the DAU STATUS is listed as NORMAL.

6.3.9 Verify that the voltages under POWER SUPPLY STATUS are within the following limits:

VOLTAGE	RANGE	
AC LINE	90 - 130 VAC	(On 220 volt units this value is half the the actual line voltage.)
BATTERY	18.5 - 22 VDC	
CB BATTERY	18.5 - 22 VDC	
RAW DC	18 - 35 VDC	
REGULATED +5	4.8 - 5.2	
REGULATED +12	11.0 - 12.4	

6.3.10 Exit from System Status screen.

6.3.11 Select & enter KEYBOARD TEST.

6.3.12 Verify that each key diagramed on the CRT functions properly (i.e. the diagrammed key on the CRT shall light while the actual key is being pressed).

6.3.13 Exit from the KEYBOARD TEST.

6.3.14 Select & enter CRT GEOMETRY.

6.3.15 Verify that the CRT is properly adjusted. Readjust, if necessary, using non-metallic tools (see Section 5.0, Adjustment and Calibration Procedures).

6.3.16 Exit from the CRT GEOMETRY screen.

6.3.17 Select and enter the KEYBOARD SELECT screen.

6.3.18 Verify that both the Main keypad and the SCR keypad are selected to Type 1 for units with Type 1 keypads, or both Main keypad and SCR keypad are selected to Type 2 for units with Type 2 keypads. See figure 2.5 for keypad configuration.

6.4 DAU Tests

6.4.1 Select DAU TEST from the Service Diagnostics Menu and press the "ENTER" key.

6.4.2 With a temperature simulator set to 37° C (98.6° F), insert a 400 series plug into the T1 connector and a 700 series plug into the T2 connector.

6.4.3 T1 and T2 shall read between 98.5° F and 98.7° F.

6.4.4 With a temperature simulator set to 37° C (98.6° F), insert a 700 series plug into the T1 connector and a 400 series plug into the T2 connector.

6.4.5 T1 and T2 shall read between 98.5° F and 98.7° F.

6.4.6 Connect a pressure simulator to the P1 input of the VA2000. Set the simulator's POLARITY toggle switch to the ZERO Position. The P1 channel shall read between 0 and 3 mm Hg.

6.4.7 Set the pressure simulator knob to 20/200 mm Hg. Set the PRESSURE toggle switch to X10. Set the POLARITY toggle switch to the POSITIVE position. The P1 channel shall read between 196 and 204 mm Hg.

6.4.8 Connect the pressure simulator to the P2 input of the Vitalert 2000. Set the simulator's POLARITY toggle switch to ZERO. The P2 channel shall read between 0 and 3 mm Hg.

6.4.9 Set the pressure simulator knob to 20/200 mm Hg. Set the POLARITY toggle switch to the POSITIVE position. Set the PRESSURE toggle switch to x10. The P2 channel shall read between 196 and 204 mm Hg.

6.4.10 Connect the ECG leads to the ECG simulator.

ECG LEAD	SIMULATOR POST
WHITE	WHITE
BLACK	**RED**
RED	**BLACK**
BROWN	BROWN
GREEN	GREEN

IMPORTANT!!
ENSURE THAT **BLACK** AND **RED** LEADS ARE CONNECTED AS INDICATED.

6.4.11 Connect the ECG cable plug into the VA2000 DAU ECG input.

6.4.12 Place the ECG Simulator Power Switch to the "BATTERY" position.

NOTE: If the green LED does not flash, replace the batteries in the simulator before proceeding.

6.4.13 Turn the BPM "RATE" knob and the "AMPLITUDE" knob on the ECG Simulator fully counter-clockwise.

6.4.14 Using the [▲] keys, move the arrow cursor to "RESET SCREEN DATA" and press "ENTER".

6.4.15 The ECG1 LO value shall read between 2040 and 2048.

6.4.16 The ECG1 HI value shall read between 2048 and 2056.

6.4.17 Adjust the ECG Simulator heart rate to 300 BPM.

6.4.18 Adjust the amplitude (knob located on the rear of the simulator) to 1 mV.

6.4.19 Configure the front panel toggle switches to the following (from left to right) positions: B, W, ×1. With the cursor still on "RESET SCREEN DATA", press "ENTER".

6.4.20 The difference in values (Δ) between ECG1 LO and ECG1 HI shall be 380 ± 8 counts. NOTE: Disregard ECG High and Low values at this time.

6.4.21 Exit from the DAU TEST screen and select MONITOR. The unit shall reset and perform power-up diagnostics.

6.4.22 If the readings of Steps 6.4.4 thru 6.4.20 are out of spec, perform the Auto Calibrations given in Section 5.2 and repeat the DAU Tests.

6.5 Setup and Configuration

6.5.1 Press the "CONFIG" key. Select VITALERT 2000 MONITORING OPTIONS. Note the current selections, verify that the selections can be changed, and return the selections to their original settings.

6.5.2 Press the "CONFIG" key. Select VITALERT 2000 AUDIO ADJUSTMENTS. Note the current selections, verify that the selections can be changed, and return the selections to their original settings.

6.5.3 Press the "CONFIG" key. Select COMMUNICATION PORT and set the parameters to match the host system's communication port configuration, if applicable.

6.5.4 Press the "CONFIG" key. Select SET TIME AND DATE. Adjust for the correct time and date, if necessary.

6.6 Pacemaker Pulse Detection

6.6.1 Verify that the ECG cable is connected to the simulator ECG posts (by color), and the VA2000.

6.6.2 Place the ECG Simulator power to the "BATTERY" position.

6.6.3 Adjust the "RATE" knob to 80 BPM.

6.6.4 Adjust the amplitude knob (located on the rear of the simulator) to 5 mV.

6.6.5 Configure the front panel toggle switches to the following (from left to right) positions: B, N, ×1.

6.6.6 Press the "CONFIG" key on the main keypad.

6.6.7 Select "MONITORING OPTIONS" then press the "ENTER" key.

6.6.8 Select the TRACE SPEED option, then press the "ENTER" key to select 50 mm/sec.

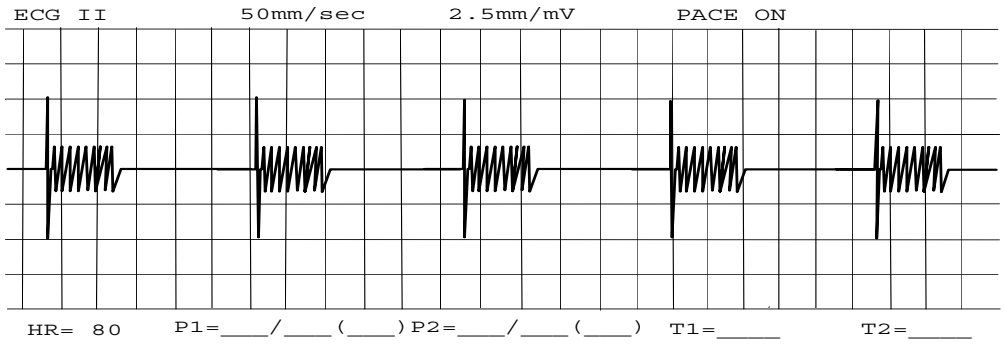
6.6.9 Select the "PACEMAKER MARK" menu option, then press the "ENTER" key as necessary to indicate "ON".

6.6.10 Press the "MONITOR" key to return to the monitor screen.

6.6.11 If the unit has Type 1 keypads, press the "ECG LEAD" key on the main keypad. If the unit has Type 2 keypads, press the "LEAD" key on the main keypad and select lead "II".

6.6.12 For Type 1 keypads, press the arrow key that corresponds with the "ECG SCALE" box displayed on the CRT. For Type 2 keypads, press the "SCALE" on the main keypad until the scale with the most horizontal tick marks appears.

6.6.13 On the SCR control key column, press the "ECG" key and verify the presence of pacemaker simulated pulses as shown in the following illustration:



6.6.14 Press the "CONFIG" key.

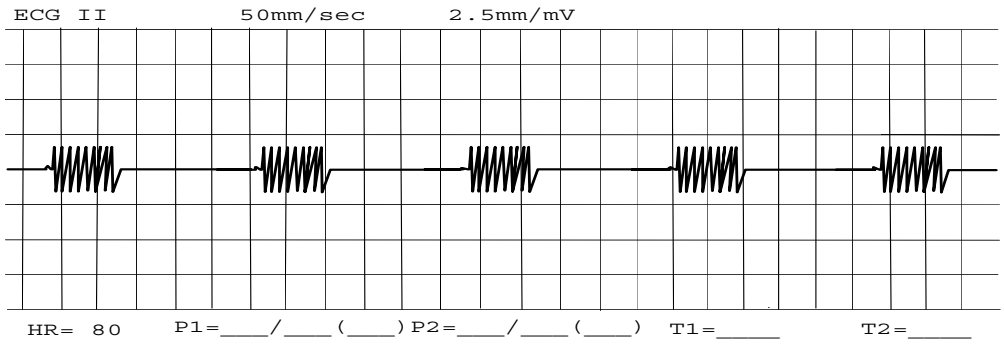
6.6.15 Select the "MONITORING OPTIONS" menu option, then press the "ENTER" key.

6.6.16 Select the "TRACE SPEED" option, press the "ENTER" key to select 25 mm/Sec.

6.6.17 Select the "PACEMAKER MARK" menu option, then press the "ENTER" key as necessary to indicate "OFF".

6.6.18 Press the "MONITOR" key.

6.6.19 Verify than no pacemaker simulated pulses appear on the ECG channel as shown in the following illustration:



6.7 Serial Data Port

6.7.1 Ensure that the VA2000 and the anesthesia or monitoring system are both in the STANDBY mode prior to connecting to the Data Port on the rear of the VA2000.

6.7.2 Turn both units ON and set up the proper protocol.

6.7.3 Verify that data is correctly passed between the anesthesia or monitoring system and the VA2000.

6.8 Alarm Limit and Audio Tests

6.8.1 Verify that the ECG cable is connected to the simulator ECG posts (by color) and the VA2000.

6.8.2 On the ECG simulator, set the toggle switches (left to right) A, W, x1.

6.8.3 Adjust the simulator heart rate to 60 bpm.

6.8.4 On the rear panel of the simulator, adjust the amplitude to 1 mV.

6.8.5 Verify that the power switch of the ECG simulator is in the upward "BATTERY" position.

6.8.6 Press the VA2000 "CONFIG" key, select and enter the "AUDIO ADJUSTMENT" selection.

6.8.7 Adjust the audio alarm volume to "LOW".

6.8.8 Press the "MONITOR" key to return to the main screen.

6.8.9 Adjust the "LO" heart rate alarm limit on the VA2000 to above 60. The warning message "HRT RATE LOW" shall appear on the CRT and a repeating audible alarm shall be clearly heard at a distance of ten feet.

6.8.10 Adjust the "LO" heart rate alarm limit below 60; the alarm message shall clear.

6.8.11 Adjust the "HI" heart rate alarm limit to below 60. The caution message "HRT RATE HI" shall appear on the CRT and an intermittent audible alarm shall be clearly heard from a distance of ten feet.

6.8.12 Adjust the "HI" heart rate alarm limit above 60; the alarm message shall clear.

6.8.13 Connect a pressure simulator to the VA2000 P1 input and set the POLARITY toggle switch to the ZERO position.

6.8.14 Press the "P1→0←" key on the main keypad of the VA2000 and allow completion of zeroing.

6.8.15 Set the pressure simulator knob to 20/200 mm Hg. Set the PRESSURE toggle switch to X10. Set the POLARITY toggle switch to the POSITIVE position. P1 shall read approx. 200 mm Hg.

6.8.16 Adjust the "LO" blood pressure alarm on the VA2000 above 200. The caution message "ART SYS LOW" shall appear on the CRT and an intermittent audible alarm shall be heard clearly from a distance of ten feet.

6.8.17 Adjust the "LO" blood pressure alarm limit to below 200; the alarm message shall clear.

6.8.18 Adjust the "HI" blood pressure alarm limit to below 200. The caution message "ART SYS HIGH" shall appear on the CRT and an intermittent audible alarm shall be heard clearly from a distance of ten feet.

6.8.19 Adjust the "HI" blood pressure alarm limit to above 200; the alarm message shall clear.

6.8.20 Connect a pressure simulator to the VA2000 P2 input and set the POLARITY toggle switch to the ZERO position.

6.8.21 Press the VA2000 "CONFIG" key, select and enter the "MONITORING OPTIONS" selection.

6.8.22 Select "P2 LABEL" and enter "CVP" label.

6.8.23 Press the "MONITOR" key to return to the main screen.

6.8.24 Press the "P2→0←" key on the main keypad of the VA2000 and allow completion of zeroing.

6.8.25 Set the pressure simulator knob to 20/200 mm Hg. Set the PRESSURE toggle switch to X1. Set the POLARITY toggle switch to the POSITIVE position. P2 shall read approx. 20 mm Hg.

6.8.26 Adjust the "LO" blood pressure alarm limit on the VA2000 to above 20. The caution message "CVP MEAN LOW" shall appear on the CRT and an intermittent audible alarm shall be clearly heard from a distance of ten feet.

6.8.27 Adjust the "LO" blood pressure alarm limit to below 20; the alarm message shall clear.

6.8.28 Adjust the "HI" blood pressure alarm limit on the VA2000 to below 20. The caution message "CVP MEAN HI" shall appear on the CRT and an intermittent audible alarm shall be clearly heard from a distance of ten feet.

6.8.29 Adjust the "HI" blood pressure alarm limit to above 20; the alarm message shall clear.

6.8.30 Press the VA2000 "CONFIG" key, select and enter the "MONITORING OPTIONS" selection.

6.8.31 Select "P2 LABEL" and enter "PA" label.

6.8.32 Press the "MONITOR" key to return to the main screen.

6.8.33 Return the pressure simulator POLARITY toggle switch to the ZERO position.

6.8.34 Press the "P2→0←" key on the main keypad of the VA2000 and allow completion of zeroing.

6.8.35 Set the POLARITY toggle switch of the pressure simulator to the POSITIVE position, leaving the PRESSURE toggle switch on X1. P2 shall read approx. 20 mm Hg.

6.8.36 Adjust the "LO" blood pressure alarm limit on the VA2000 to above 20. The caution message "PA DIAS LOW" shall appear on the CRT and an intermittent audible alarm shall be clearly heard from a distance of ten feet.

6.8.37 Adjust the "LO" blood pressure alarm limit to below 20; the alarm shall clear.

6.8.38 Adjust the "HI" blood pressure alarm limit to below 20. The caution message "PA DIAS HIGH" shall appear on the CRT and an intermittent audible alarm shall be heard clearly from a distance of ten feet.

6.8.39 Adjust the "HI" blood pressure alarm limit above 20; the alarm message shall clear.

6.8.40 Press the VA2000 "CONFIG" key, select and enter the "MONITORING OPTIONS" selection.

6.8.41 Select the "P2 LABEL" and enter the "ART" label.

6.8.42 Press the "MONITOR" key to return to the main screen.

6.8.43 Return the pressure simulator POLARITY toggle switch to the ZERO position.

6.8.44 Press the "P2→0←" key on the main keypad of the VA2000 and allow completion of zeroing.

6.8.45 Set the PRESSURE toggle switch of the simulator to X10 and the POLARITY toggle switch to the POSITIVE position. P2 shall read approx. 200 mm Hg.

6.8.46 Adjust the "LO" blood pressure alarm limit on the VA2000 to above 200. The caution message "PA SYS LOW" shall appear on the CRT and an intermittent audible alarm shall be clearly heard at a distance of ten feet.

6.8.47 Adjust the "LO" blood pressure alarm limit to below 200; the alarm message shall clear.

6.8.48 Adjust the "HI" blood pressure alarm limit to below 200. The caution message "P2 SYS HIGH" shall appear on the CRT and an intermittent audible alarm shall be heard from a distance of ten feet.

6.8.49 Adjust the "HI" blood pressure alarm limit above 200; the alarm mesage shall clear.

6.8.50 Press the VA2000 "CONFIG" key, return "AUDIO ADJUSTMENT" selection to its original setting, then return "MONITORING OPTIONS" "P2 LABEL" to its original setting.

6.8.51 Press the "MONITOR" key to return to the main screen.

6.9 Strip Chart Recorder

6.9.1 On the SCR control column, press the "ECG" key. Verify that the SCR produces a hardcopy of the ECG waveform displayed on the CRT.

6.9.2 On the SCR control column, press the "DATA" key. Verify that the SCR produces a printout of numerical data. Verify that the time and date are correct.

6.10 Reset Error Log and Service Date

6.10.1 Re-enter the Service Menu. Select and enter ERROR LOG and evaluate error messages for severity (contact NAD Service Department if necessary) then press EXIT.

6.10.2 Select and enter the SERVICE LOG.

6.10.3 Record the Date Last Serviced on the PMS form.

6.10.4 Record the Hours Since Serviced on the PMS form.

6.10.5 Record the Total Hours on the PMS form.

6.10.6 Press the "RESET SERVICE DATE" key and verify that the last service date is the current date.

6.10.7 Press "CLEAR ERROR LOG".

6.10.8 Press the "EXIT" key and then the "MONITOR" key.

6.10.9 Verify that all power-up tests pass and the unit is labeled FUNCTIONAL.

6.11 Reserve Power Test

6.11.1 Verify that the RESERVE POWER TEST PASS message appears on the power-up diagnostics screen.

6.11.2 Disconnect the AC line cord and allow the unit to operate on its internal battery for five minutes. Verify that the unit is operating properly at the end of the five minute period.

NOTE: A Low Battery message may appear on the display while the unit is operating on battery power.

6.11.3 Restore AC power to the unit, turn to STANDBY mode and disconnect all test equipment.

6.12 Accessory Attachments

Attach each accessory item to its intended location. Repair or replace any item that cannot be properly attached.

6.13 Visual Inspection

Inspect all surfaces of the instrument. Replace labels, disposable items and damaged parts as necessary.

6.14 Operator Manual

Verify the availability/location of the VITALERT 2000 Operator's Manual.

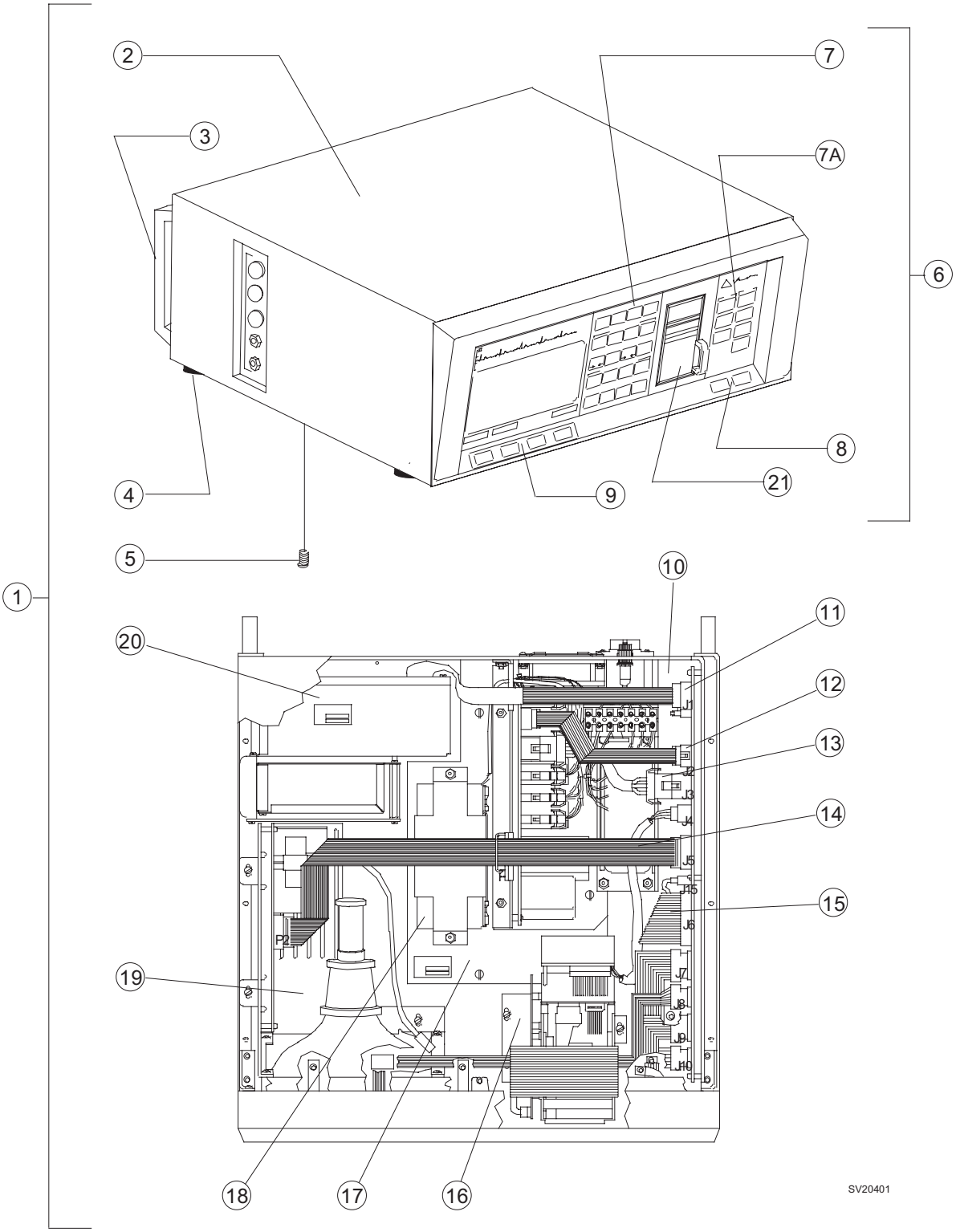


Figure 7-1. VITALERT 2000 Monitoring System

ITEM	DESCRIPTION	PART NUMBER
1	VITALERT 2000	4110376
	VITALERT 2000E	4111090
2	Chassis Cover Assembly	4110345
3	Handle (2x)	2208115
4	Foot (4x)	4110160
5	Screw, Cover (8x)	HW09004
6	Bezel Assembly	4110248
7	Main Keypad and CRT Filter Assembly	4110263
7A	Recorder Keypad and Panel Assembly	4110264
8	On/Standby Keypad	4109885
9	CRT Keypad	4109884
10	Processor Assembly	4109996
	Processor PCB Assembly, (Rev. Y and later recognizes Desflurane and Sevoflurane data)	4109932
11	Cable Assembly, DAU - Processor	4110551
12	Cable Assembly, Power Supply - Processor	4110353
13	Wire Harness, Power Supply - Processor	4110355
14	Cable Assembly, CRT - Processor	4110352
15	Cable Assembly, Strip Chart Recorder - Processor	4110350
16	Strip Chart Recorder Assembly	4109984
17	Power Supply Assembly, VA2000 - 115V	4111087
	Power Supply Assembly, VA2000E - 230V	4111089
18	Battery Pack, 18V Rechargeable	4110155
19	CRT Assembly	4109994
20	DAU Assembly	4109995
	Replaced by	SE4112982
21	Roller, Molded Assembly, Strip Chart Recorder	4116667
	Power Cord Assembly	4110333
	Power Cord, Export	4109600
	Data Cable Assembly, DB9 - DB9, 2.5 ft. long	4110328
	Paper Roll, Strip Chart Recorder	4110335
	VITALERT 2000 Monitoring System PMS Form	S010027

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Vitalert 2000 Service Manual

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7-1 ..... Added new item number 21
7-2 ..... Added new item number 21

Rev. M summary of changes

ii ..... Revised page listing for parts section